



Total Maximum Daily Load

for

Spring River Watershed

Barry, Barton, Christian, Dade, Jasper, Stone, and Lawrence counties

303(d) Listing: *Escherichia coli* Bacteria

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Water Body Summary
Total Maximum Daily Loads (TMDL) for Spring River Watershed
303(d) Listing: *Escherichia coli* (*E. coli*) Bacteria

Names: Spring River, North Fork Spring River, Opossum Creek, Honey Creek, Duval Creek, Dry Fork, Dry Hollow Creek, Slater Branch, Spring River tributary, Truitt Creek, White Oak Creek, and Williams Creek

Location: Barry, Barton, Christian, Dade, Jasper, Stone, and Lawrence counties



TMDL Development Priority: Low

8-digit Hydrologic Unit Codes (HUC):¹
 11070207 – Spring

Location of watershed in Missouri

Water Body Identification (WBID), Hydrologic Class², Designated Uses³, Impaired Use, and Year Listed on 303(d) List:

Stream Name	WBID	Class	Designated Uses	Impaired Use	Year Listed
Spring River	3160	P	WWH, CLH, WBC-A, SCR, HHP, IRR, LWP, IND	WBC-A	2006
Dry Hollow Creek	3163	C	WWH, WBC-B, SCR, HHP, IRR, LWP	WBC-B ⁴ , SCR	2016
Spring River	3164	P	WWH, CDH, WBC-A, SCR, HHP, IRR, LWP, IND	WBC-A	2010
Spring River	3165	P	WWH, WBC-A, SCR, HHP, IRR, LWP	WBC-A	2010
Spring River Tributary	4112 ⁵	C	WWH, WBC-B, SCR, HHP, IRR, LWP	WBC-B	2018

¹ Watersheds are delineated by the U.S. Geological Survey using a nationwide system based on surface hydrologic features. This system divides the country into 2,270 8-digit hydrologic units (USGS 2024a). A hydrologic unit is a drainage area delineated to nest in a multilevel, hierarchical drainage system. A hydrologic unit code is the numerical identifier of a specific hydrologic unit consisting of a 2-digit sequence for each specific level within the delineation hierarchy (FGDC 2003).

² For hydrologic classes see 10 CSR 20-7.031(1)(E). Class P streams maintain permanent flow even in drought periods. Class C streams may cease flow in dry periods but maintain permanent pools which support aquatic life.

³ For designated uses see 10 CSR 20-7.031(1)(F) and 10 CSR 20-7.031 Table H. Presumed uses are assigned per 10 CSR 20-7.031(2)(A) and (B) and are reflected in the Missouri Use Designation Dataset described at 10 CSR 20-7.031(2)(F).

⁴ Available data show that Dry Hollow Creek is exceeding criteria for whole body contact recreation category B (WBC-B) and will be included on the 2026 303(d) list as such. Therefore, it is included here as an impaired use.

⁵ Spring River tributary and the associated WBID of 4112 are temporary designations for the purpose of assessment. The name and WBID are not listed in 10 CSR 20-7.031 Table H. Instead, the water body is included in the Presumed Use Streams entry associated with its HUC8 of Spring – 11070207. This entry in Table H gives the designated uses listed above and in Section 3.1

Stream Name	WBID	Class	Designated Uses	Impaired Use	Year Listed
Honey Creek	3169	P	WWH, WBC-B, SCR HHP, IRR, LWP	WBC-B, SCR ⁶	2010
Honey Creek	3170	C	WWH, WBC-B, SCR, HHP, IRR, LWP	WBC-B	2010
Williams Creek	3171	P	WWH, CDH, WBC-A, SCR, HHP, IRR, LWP	WBC-A	2010
Williams Creek	3172	P	WWH, WBC-A, SCR, HHP, IRR, LWP	WBC-A, SCR ⁷	2010
Truitt Creek	3174	P	WWH, WBC-B, SCR, HHP, IRR, LWP	WBC-B, SCR ⁸	2016
Truitt Creek	3175	C	WWH, SCR, HHP, IRR, LWP	SCR	2012
White Oak Creek	3182	C	WWH, WBC-A, SCR, HHP, IRR, LWP	WBC-A	2010
North Fork Spring River	3186	P	WWH, WBC-B, SCR, HHP, IRR, LWP	WBC-B	2008
North Fork Spring River	3188	C	WWH, WBC-B, SCR, HHP, IRR, LWP	WBC-B	2008
Dry Fork	3189	C	WWH, WBC-A, SCR, HHP, IRR, LWP	WBC-A	2008
Opossum Creek	3190	C	WWH, WBC-B, SCR, HHP, IRR, LWP	WBC-B	2018
Duval Creek	3199	C	WWH, WBC-B, SCR, HHP, IRR, LWP	WBC-B	2016
Slater Branch	3754	C	WWH, WBC-B, SCR, HHP, IRR, LWP	WBC-B	2014

- WWH - Protection and propagation of fish, shellfish, and wildlife – warm water habitat
 CLH - Protection and propagation of fish, shellfish, and wildlife - cool water habitat
 CDH - Protection and propagation of fish, shellfish, and wildlife - cold water habitat
 WBC-A - Whole body contact recreation category A
 WBC-B - Whole body contact recreation category B
 SCR - Secondary contact recreation
 HHP - Human health protection
 IRR - Irrigation
 LWP - Livestock and wildlife protection
 IND - Industrial water supply

Pollutant Identified on the 2022 303(d) List:

Escherichia coli (*E. coli*) (fecal indicator bacteria)

⁶ Available data show that Honey Creek (3169) is exceeding criteria for secondary contact recreation (SCR) and will be included on the 2026 303(d) list as such. Therefore, SCR is included here as an impaired use.

⁷ Available data show that Williams Creek (3172) is exceeding criteria for SCR and will be included on the 2026 303(d) list as such. Therefore, SCR is included here as an impaired use.

⁸ Available data show that Truitt Creek (3174) is exceeding criteria for SCR and will be included on the 2026 303(d) list as such. Therefore, SCR is included here as an impaired use.

Identified Sources on the 2022 303(d) List:

Source	WBID
Rural nonpoint sources	3160, 3164, 3165, 3186, 3188, 3190, 3169, 3170, 3189, 3174, 3175, 3182, 3171, 3172
Nonpoint Source	3199, 3754, 4112
Source Unknown	3163

Length, Location, and Watershed Size of Impaired Segments:

Name	WBID	Length (mi)	Watershed Size (mi²)	Downstream Limit (PLSS⁹)	Upstream Limit (PLSS)
Spring River	3160	61.7	1,179.47	State Line	20,28N,27W
Dry Hollow Creek	3163	0.5	19.66	Mouth	22,28N,28W
Spring River	3164	8.8	215.35	20,28N,27W	13,27N,27W
Spring River	3165	11.9	66.75	13,27N,27W	28,26N,26W
Spring River tributary	4112	4.0	3.86	Mouth	6,28N,31W
Honey Creek	3169	16.5	67.57	Mouth	22,27N,25W
Honey Creek	3170	2.7	11.39	22,27N,25W	35,27N,25W
Williams Creek	3171	1.0	54.48	Mouth	28,28N,27W
Williams Creek	3172	8.5	53.91	28,28N,27W	34,28N,26W
Truitt Creek	3174	1.5	28.46	Mouth	23,28N,27W
Truitt Creek	3175	5.2	25.19	23,28N,27W	5,28N,26W
White Oak Creek	3182	18.0	63.20	Mouth	2,29N,28W
North Fork Spring River	3186	17.4	641.71	Mouth	6,29N,32W
North Fork Spring River	3188	55.9	374.66	6,29N,32W	20,30N,28W
Dry Fork	3189	10.2	95.65	Mouth	8,29N,30W
Opossum Creek	3190	6.4	14.17	Mouth	28,30N,30W
Duval Creek	3199	7.0	19.55	Mouth	13,30N,32W
Slater Branch	3754	3.7	3.49	Mouth	34,30N,32W

⁹ The Public Land Survey System (PLSS) is a way of subdividing and describing land in the United States. (USGS 2024b)

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1. Introduction

In accordance with Section 303(d) of the federal Clean Water Act, the Missouri Department of Natural Resources is establishing this restorative total maximum daily load (TMDL) to address elevated concentrations of *Escherichia coli* (*E. coli*) bacteria in 18 water quality limited stream segments within the Spring River watershed in southwest Missouri.¹⁰ These 18 streams are included on Missouri's 2022 303(d) List of Impaired Waters due to exceedances of Missouri's *E. coli* bacteria criteria. These listings were approved by the U.S. Environmental Protection Agency (EPA) on August 2, 2023¹¹. All 18 streams addressed by this TMDL are upstream and within the watershed of where the Spring River flows west into Kansas. The watershed delineated from this point at the border has a total area of 1,179.47 mi² where 0.58 mi², or 0.05%, of that area is draining from Kansas. Due to the small relative size, no permitted point sources, and no water bodies flowing out of Kansas as a part of the Spring River watershed, the potential loading from Kansas is considered negligible. Therefore, this TMDL document will be considered a single-state watershed TMDL, and it is assumed, in accordance with federal regulation 40 CFR 131.10(b), that any out of state contributions will meet Missouri's water quality standards at the state border.

Section 303(d) of the federal Clean Water Act and Title 40 of the Code of Federal Regulations (CFR) Part 130 require states to develop TMDLs for waters that do not meet applicable water quality standards. Missouri's Water Quality Standards at Title 10 of the Code of State Regulations (CSR) Division 20 Chapter 7, Rule 7.031 consists of three major components: designated uses, water quality criteria to protect those uses, and an antidegradation policy. A TMDL is equal to the loading capacity of a water body for a specific pollutant and represents the maximum amount of a pollutant that a water body can assimilate and still attain and maintain water quality standards. The *E. coli* bacteria loading capacity for an impaired stream is derived from the maximum *E. coli* concentration allowed by Missouri's Water Quality Standards and is translated to mass loads using stream flow under all recorded conditions. Once the loading capacity of a water body has been quantified, existing and future point sources and nonpoint sources are assessed for their potential to contribute the pollutants of concern. In accordance with 40 CFR 130.2, contributing point sources are assigned a portion of the available loading capacity as a wasteload allocation and nonpoint sources are assigned a load allocation. In accordance with federal Clean Water Act section 303(d)(1)(C), a margin of safety is also included. Margins of safety can be explicit (numeric) or implicit (qualitative) to account for any lack of knowledge concerning the relationship between pollutant loading and water quality, uncertainty associated with the model assumptions, or data inadequacies (40 CFR 130.7). The TMDL for any given pollutant is the sum of the wasteload allocation, the load allocation, and the margin of safety.

This document also aims to establish a protective TMDL for an additional 32 streams within the Spring River watershed, as listed in Appendix J under Table 93J. While none of these water bodies are currently impaired for bacteria, the goal is to maintain water quality standards in these water bodies and prevent future impairments with the allocations set forth in this TMDL.

¹⁰ A water quality limited segment is any segment where it is known that water quality does not meet applicable water quality standards or is not expected to meet applicable water quality standards, even after the application of the technology-based effluent limitations required by sections 301(b) and 306 of the federal Clean Water Act (40 CFR 130.2).

¹¹ The department maintains current and past 303(d) lists and corresponding assessment worksheets online at: dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/impaired-waters.



Spring River (3160) at Maple Road. 73.3 ft³/s discharge and 1.01 ft gage height. MoDNR file photo. September 2024.

2. Watershed Description

The Spring River watershed is located in southwest Missouri. The river, and its tributaries, take a generally westward flow into Kansas where it turns south and flows into Oklahoma before discharging into the Grand Lake O' the Cherokees. This watershed is located within the Spring 8-digit HUC 11070207. The impaired stream segments addressed by this TMDL are within four smaller, 10-digit HUCs and its total watershed area is approximately 1,179.47 square miles. Missouri counties intersecting the watershed include parts of Barry, Barton, Christian, Dade, Jasper, Stone, and Lawrence counties. For purposes of this TMDL, the Spring River watershed includes all areas within Missouri draining to water body ID 3160 of the Spring River, which includes the subwatersheds of the 18 *E. coli* impaired water bodies addressed in this report. All other subwatersheds are listed with their watershed size in the Water Body Summary. Due to scale and number of impairments included, Figures 1 (western) and 2 (eastern) are used to show the location of the impaired segments within the Spring River watershed. Maps of individual subwatersheds for each impaired water body segment are provided in Appendix D, Figures 63D through 80D.

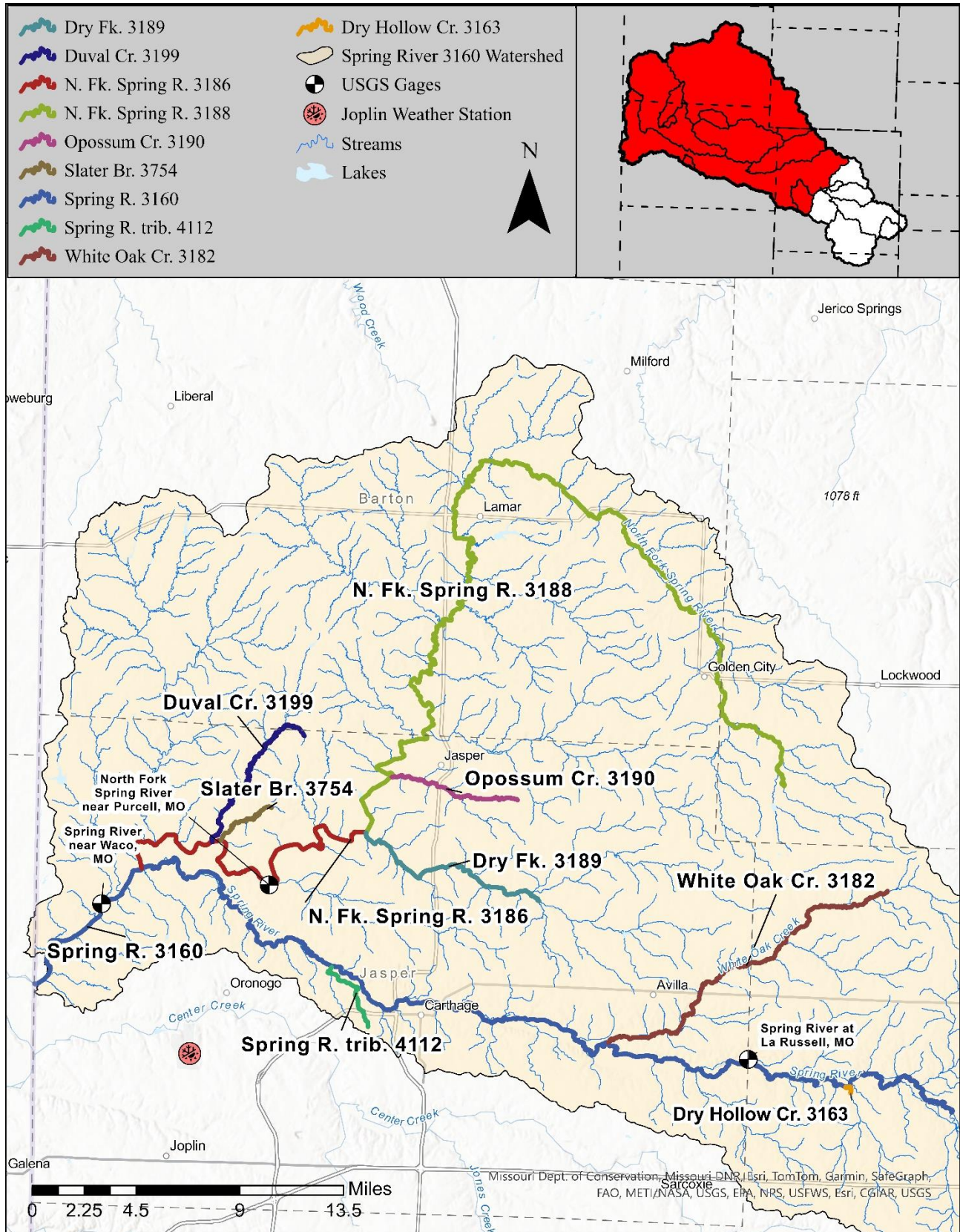


Figure 1. Location of *E. coli* impaired stream segments on the west side of the Spring River Watershed.

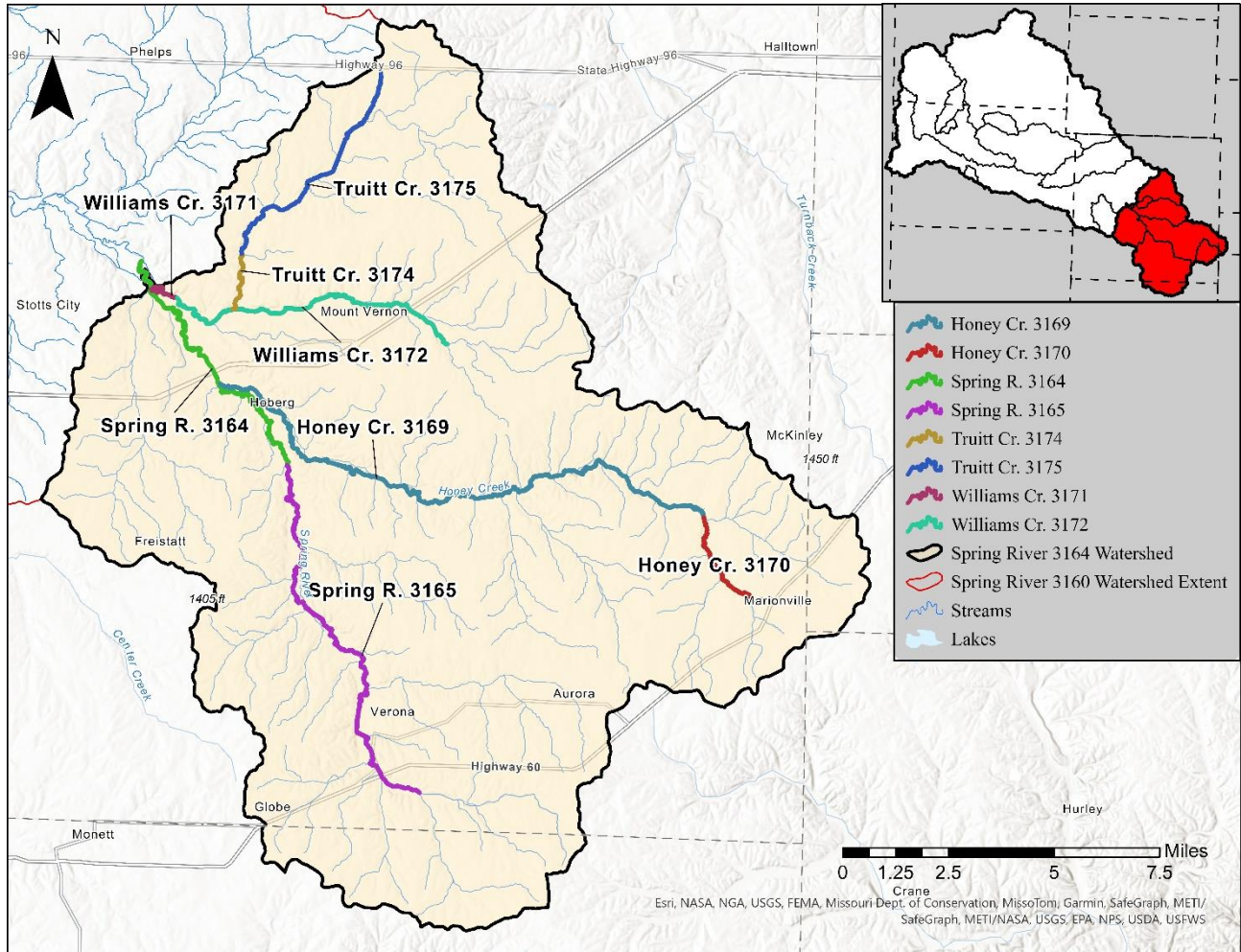


Figure 2. Location of *E. coli* impaired stream segments on the east side of the Spring River Watershed.

2.1 Geology, Physiography, and Soils

The Spring River watershed is located within the Neosho ecological drainage unit in the Ozark aquatic subregion. Ecological drainage units are aggregates of drainages within a distinct physiographic setting that share a common evolutionary history (MoRAP 2005). The Neosho ecological drainage unit is a transitional area that lacks distinctive features and shares many of the characteristics and aquatic biota of the Central Plains in the north and the Ozarks in the south. The Ozark aquatic subregion, which encompasses the Neosho ecological draining unit, is one of three subregions in Missouri that differ in geology, topology, and soils, and influence the distribution of aquatic life in the state. In general, streams in the Ozark aquatic subregion are heavily influenced by karst topography including increases in surface flows from springs or reductions due to losing streams. Missouri's Water Quality Standards at 10 CSR 20-7.031(1)(O) define a losing stream as a stream which distributes 30% or more of its flow during low flow conditions through natural processes, such as through permeable geologic materials into a bedrock aquifer within two miles flow distance downstream of an existing or proposed discharge. Five of the water bodies addressed by this TMDL have losing stream segments. They are Spring River (3164 & 3165), Dry Hollow Creek (3163), Honey Creek (3169), and Truitt Creek (3175). Streams in this subregion typically

have lower nutrient loads, cooler temperatures, and higher concentrations of dissolved oxygen (MoRAP 2005).

Ecoregions are areas with similar ecosystems and environmental resources and are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. By recognizing spatial differences in ecosystems, ecoregions stratify the environment by its probable response to disturbance (Chapman et al. 2002). Ecoregions are defined in Missouri's Water Quality Standards at 10 CSR 20-7.031(1)(H). In Missouri, the Spring River watershed lies within portions of two, level IV ecoregions, the Springfield Plateau and the Cherokee Plains. Approximately 70% of the watershed is in the Springfield Plateau and 30% within Cherokee Plains. The Springfield Plateau ecoregion is a transitional area sharing traits of the plains as well as the Ozarks. This ecoregion is characterized by its rocky soils and numerous karst features. Historical lead and zinc mining operations have disturbed much of this region and large areas of barren land and mine tailings are present. The Cherokee Plains ecoregion is characterized by its relatively flat topography and claypan soils. Although less fertile than other prairie ecoregions in Missouri, the Cherokee Plains ecoregion is more suitable for cropland agriculture than the southern portions of the Spring River watershed (Chapman et al. 2002).

Soils in the watershed are categorized into hydrologic soil groups based on similar runoff potentials. Each hydrologic soil group indicates the rate at which water enters the soil profile under conditions of a bare, thoroughly wetted soil surface (NRCS 2009). This infiltration rate determines the quantity of precipitation that flows over land to water bodies as direct runoff. Group A soils have the highest rate of infiltration and the lowest runoff potential. Group D soils have the lowest rate of infiltration and highest runoff potential. Many wet soils fall into dual soil groups (e.g., Group C/D) due to the presence of a seasonal high-water table that results in saturation to the soil surface. Dual hydrologic soil groups account for this condition by providing both the drained and undrained condition of the soil.¹² It should be noted that soil runoff potential is only one factor that determines the volume of runoff in a watershed. Impervious surfaces, vegetative cover, slope, rainfall intensity, and land use can significantly influence the potential for runoff regardless of the characteristics of the underlying soil. Figure 3 shows the distribution of hydrologic soil groups in the Spring River watershed, as well as known springs, sinkholes, and losing streams. Table 1 provides a summary of the hydrologic soil groups in the Spring River watershed by area. See Appendix F, Tables 58F through 74F for tables summarizing hydrologic soil group composition for each individual impaired subwatershed addressed by this TMDL.

¹² For the purpose of hydrologic soil group, adequately drained means that the seasonal high-water table is kept at least 24 inches (60 centimeters) below the surface in a soil where it would be higher in a natural state (NRCS 2009).

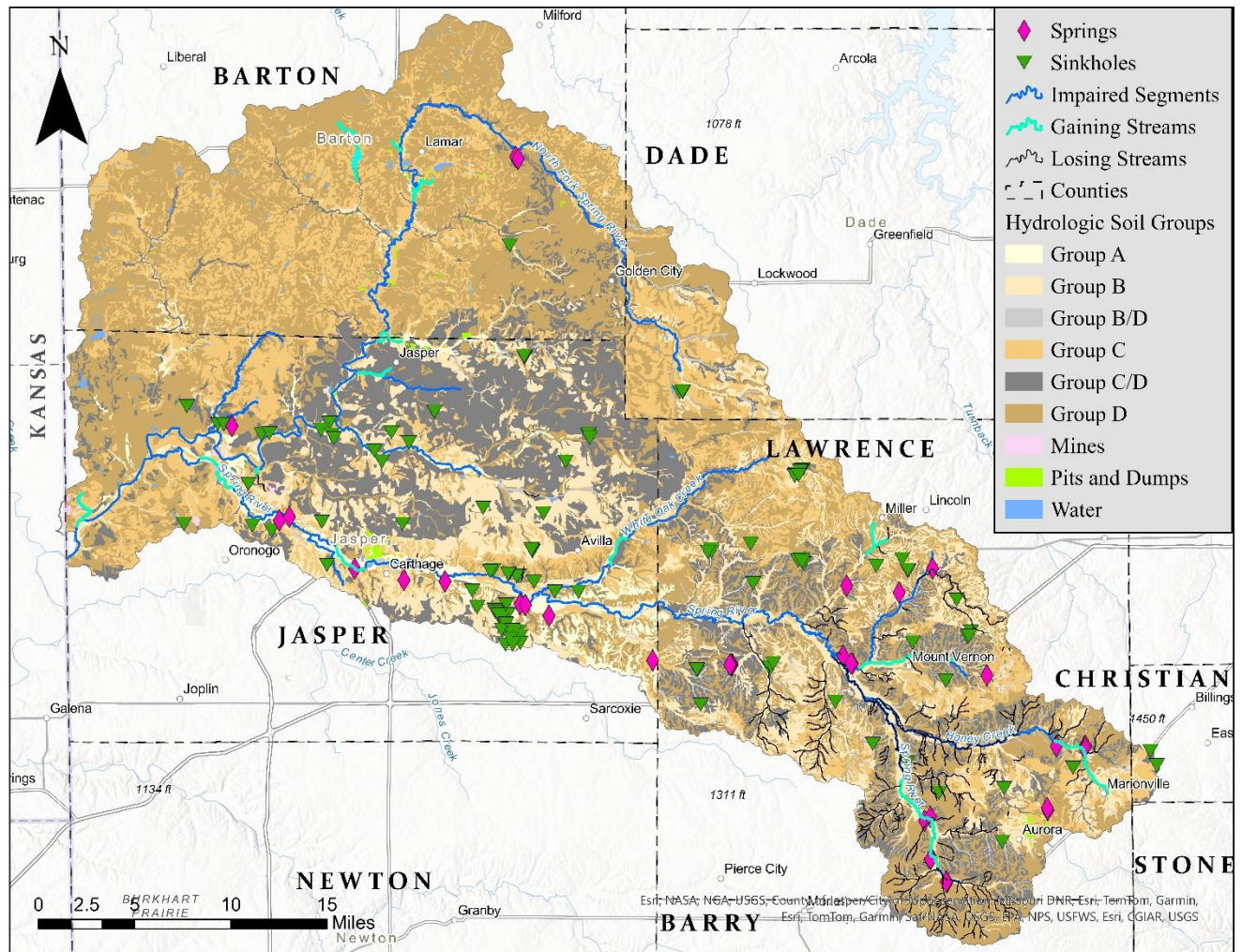


Figure 3. Hydrologic soil groups and karst features in the Spring River watershed.

Table 1. Hydrologic soil group composition in the Spring River watershed (NRCS 2023)

Hydrologic Soil Group ¹³	Area in the Watershed	
	Square Miles	Percent
Group A	29.48	2.50%
Group B	180.94	15.35%
Group B/D	20.64	1.75%
Group C	252.15	21.38%
Group C/D	225.68	19.15%
Group D	462.39	39.23%
Mines	1.07	0.09%
Pits and Dumps	2.66	0.23%
Water	3.71	0.32%
Total	1,178.72*	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in Section 2.

2.2 Climate

The most recent climate data from a weather station near the Spring River watershed were measured at the National Centers for Environmental Information Joplin Regional Airport Weather Station (USW00013987) in Jasper County, MO. The climate normals were developed based on temperature and precipitation data collected at that station between 1991 and 2020 (NOAA 2020). Precipitation normals are especially important because they relate to stream flow and runoff events that influence pollutant loading. Table 2 presents the 30-year monthly climate normals from the Joplin Regional Airport Weather Station for precipitation and temperature. Figures 4 and 5 further summarize these data.

¹³ The groups of mines, pits and dumps, and water are combined into one ‘not rated’ group in the NRCS data but for this TMDL they have been broken down into these groups for better clarity.

Table 2. 30-year monthly climate normals at Joplin Regional Airport weather station

Month	Precipitation Total	Minimum Temperature	Maximum Temperature
	inches	°F	°F
January	1.92	25.0	44.8
February	1.98	28.7	50.0
March	3.29	37.4	59.8
April	4.99	46.6	69.2
May	6.56	56.0	77.0
June	5.60	65.3	85.9
July	3.97	69.5	90.3
August	3.36	67.9	90.0
September	4.18	59.4	82.0
October	3.80	47.9	70.7
November	3.33	37.1	58.4
December	2.60	28.5	47.8
	Total	Average	Average
	45.58	47.4	68.8

Although precipitation amounts have been found to correlate with erosion rates at the local level (Mishra et al. 2019), rainfall intensity is more indicative of soil erosion potential than the quantity of precipitation alone. Rainfall intensity is the amount of rain that falls over time. Compared with moderate rainfall, heavy rainfall and storm rainfall are more likely to cause erosion (Meng et al. 2021). High rainfall intensity occurs when a large amount of rain falls in a short time. Climate warming models predict increases in the intensity of rainfall, especially convective rainfall, which produces short and local heavy rainfall (Martel et al. 2021).

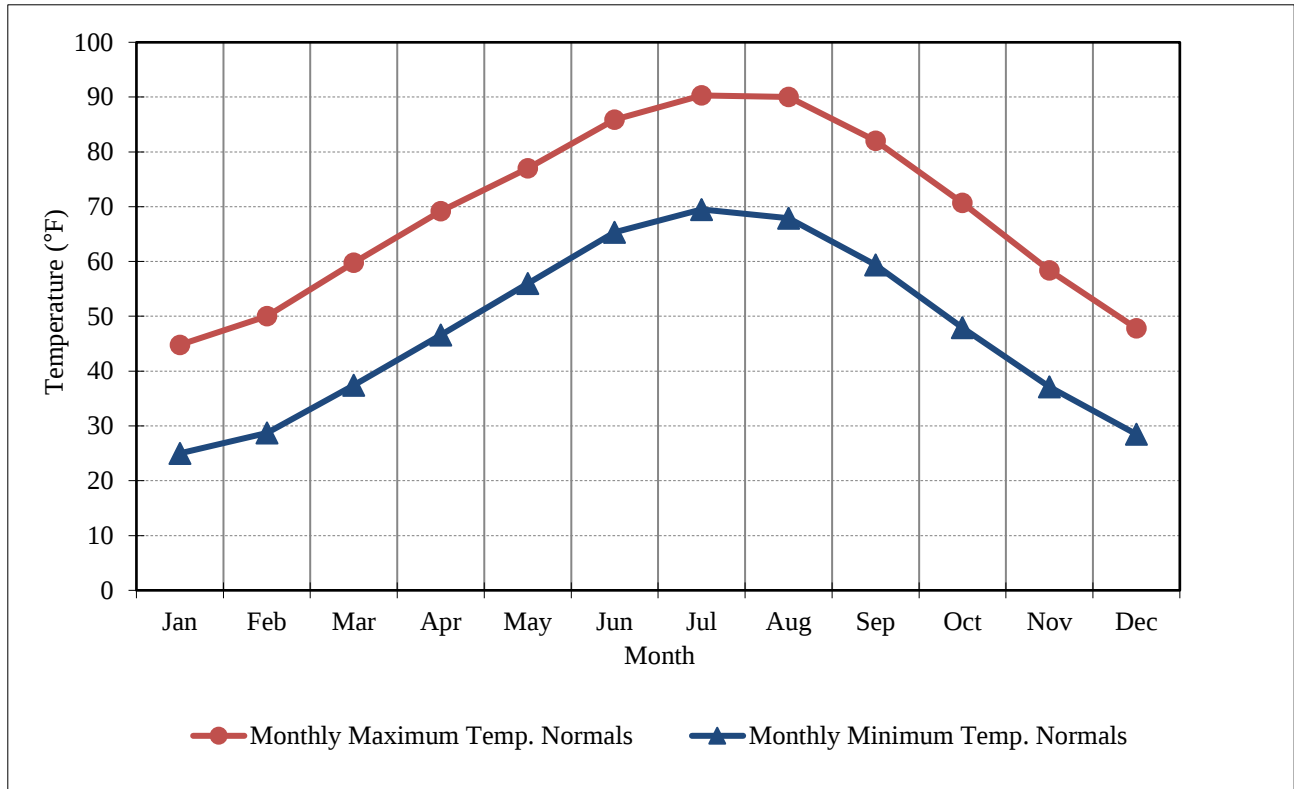


Figure 4. Monthly temperature normals at the Joplin Regional Airport weather station

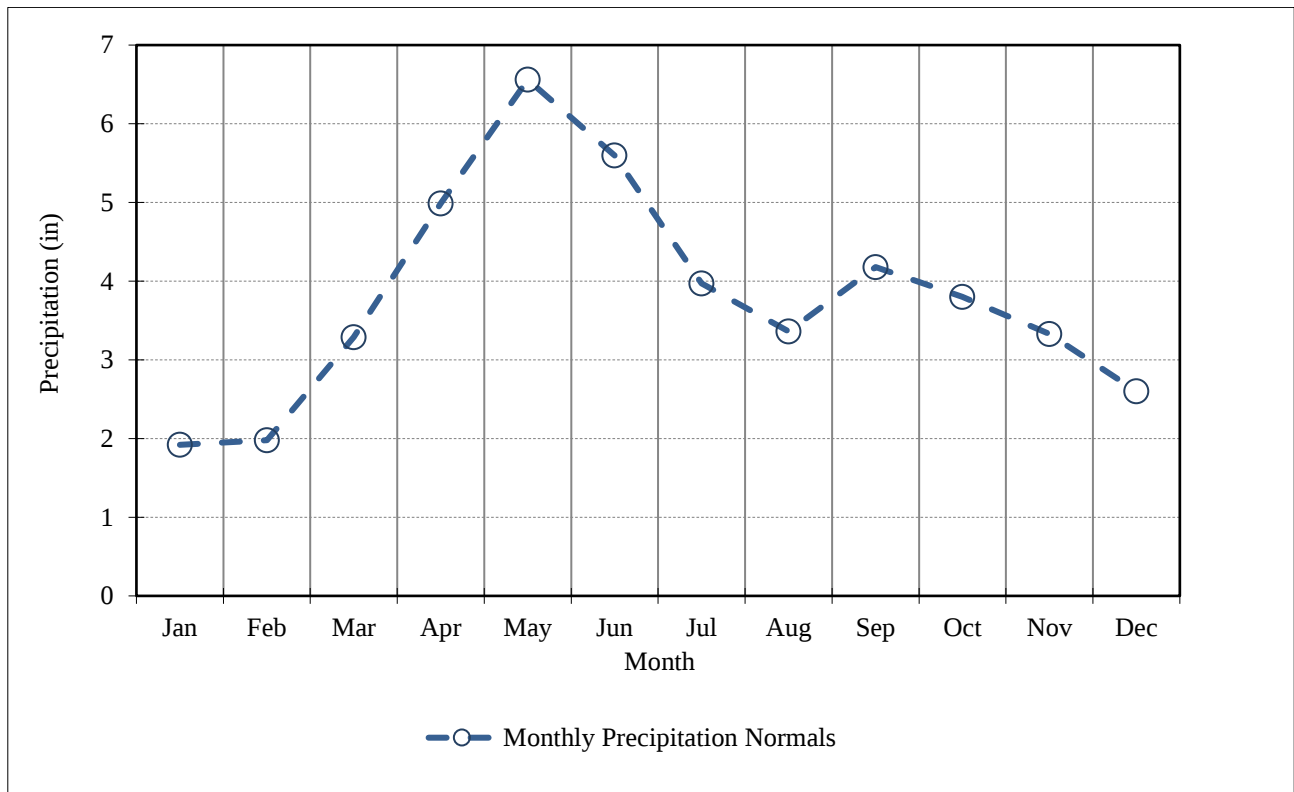


Figure 5. Monthly precipitation normals at the Joplin Regional Airport weather station

2.3 Population

State and county population estimates are available from the U.S. Census Bureau's 2020 census and can be localized using census block data (U.S. Census Bureau 2020). Population estimates for the Spring River watershed were derived using geographic information system (GIS) software by overlaying the watershed boundary over a map of census blocks (Figure 6). Wherever the centroid of a census block fell within the watershed boundary, the entire population of the census block was included in the total. If the centroid of the census block was outside the boundary, the population of the entire block was excluded. The municipal population was estimated using a similar method whereby municipal boundaries were overlain on the map of census blocks. The rural population was calculated as the difference between the municipal population and the total population. As shown in Table 3, the population in the Spring River watershed slightly increased between the 2010 and 2020 census.

Table 3. Population estimates for the Spring River watershed.

Municipal			Rural			Total		
2000	2010	2020	2000	2010	2020	2000	2010	2020
36,193	38,293	38,396	22,936	25,120	25,035	59,129	63,413	63,431
Percent Change	5.48%	0.27%	--	8.69%	-0.34%	--	6.76%	0.03%

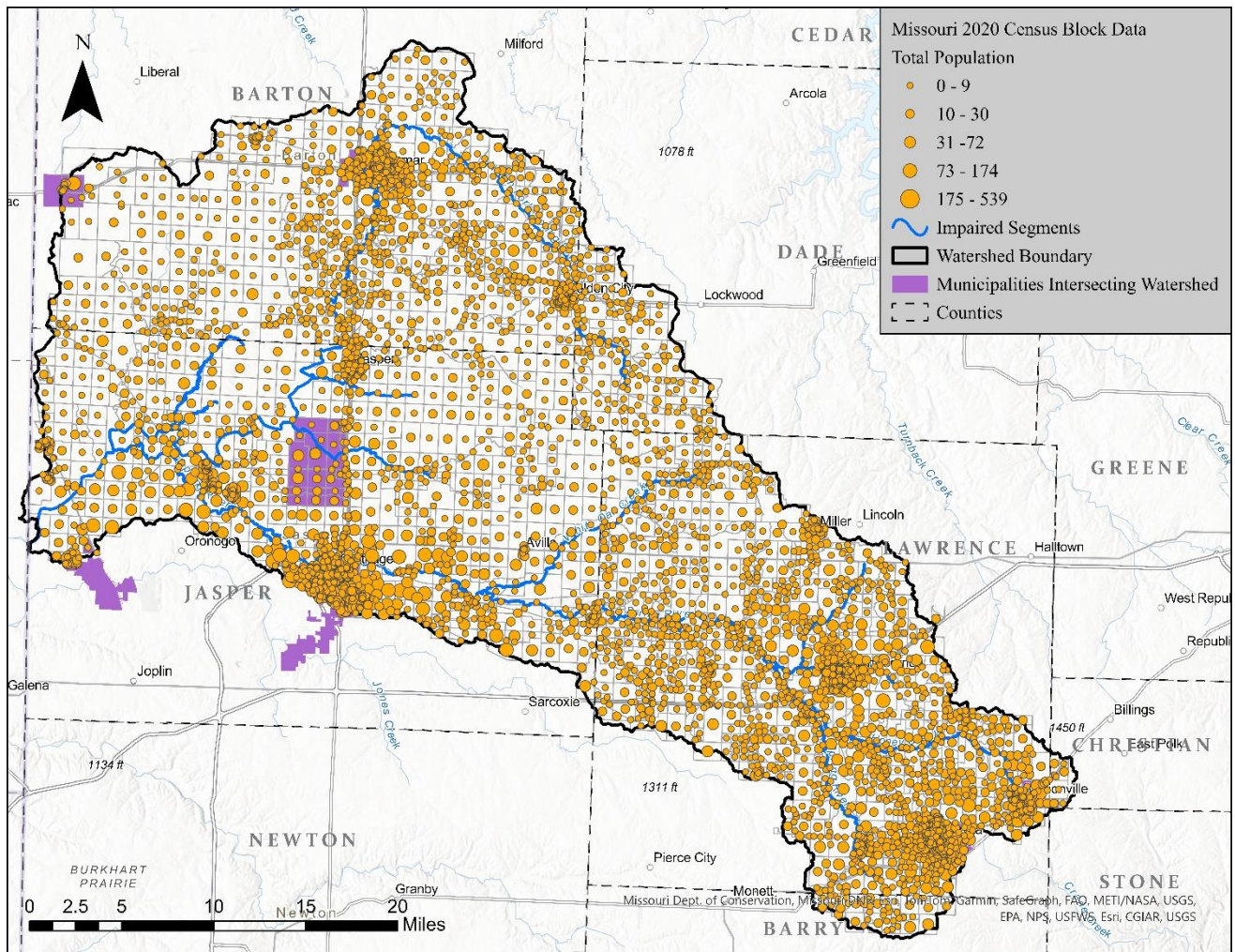


Figure 6. 2020 population in the Spring River watershed

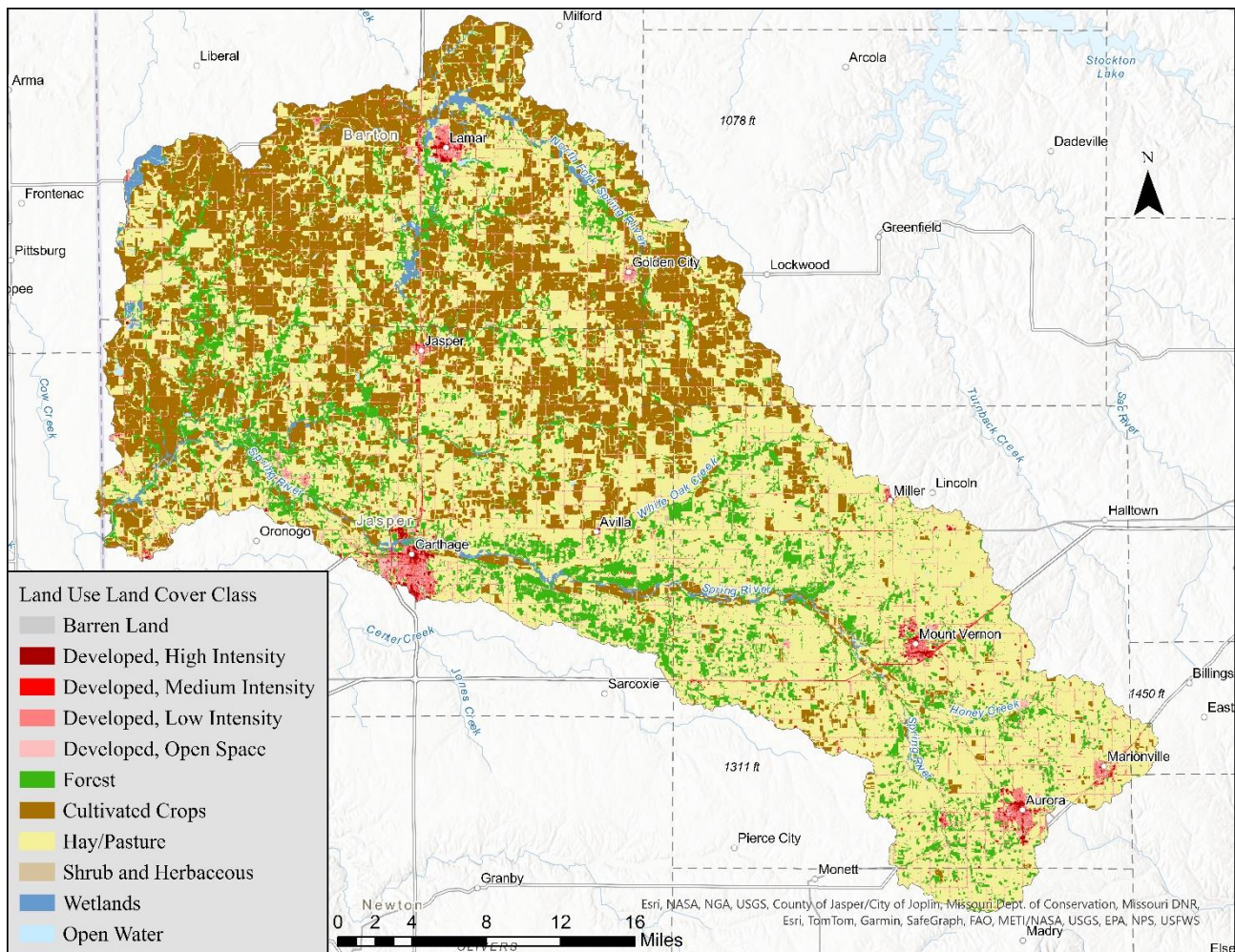
2.4 Land Cover

A land cover analysis was completed using the 2019 National Land Cover Database published by the U.S. Geological Survey (USGS) (Dewitz 2019). Land cover types present in the Spring River watershed are summarized in Table 4. Appendix G, Tables 75G through 91G, summarize land cover composition for all other impaired water bodies addressed by this TMDL. Figure 7 shows the distribution of the land cover types throughout the Spring River watershed. Areas available for agricultural land uses (i.e., Hay and Pasture, and cultivated crops) cover the majority of the watershed, while forested lands make up lower portions of land cover in the watershed. Developed areas account for less than 5% of the entire watershed area.

Table 4. Land cover composition in the Spring River watershed

Land Cover Type	Total Watershed		Missouri Only	
	Area (mi ²)	Percent	Area (mi ²)	Percent
Developed, High Intensity	2.69	0.23%	2.69	0.23%
Developed, Medium Intensity	10.21	0.87%	10.20	0.87%
Developed, Low Intensity	29.02	2.46%	29.00	2.46%
Developed, Open Space	35.25	2.99%	35.23	2.99%
Barren Land	0.74	0.06%	0.73	0.06%
Cultivated Crops	326.88	27.71%	326.59	27.70%
Hay and Pasture	607.55	51.51%	607.36	51.52%
Scrub and Herbaceous	5.90	0.50%	5.90	0.50%
Forest	140.19	11.89%	140.15	11.89%
Wetlands	16.15	1.37%	16.15	1.37%
Open Water	4.89	0.41%	4.89	0.41%
Totals	1,179.47	100.00%	*1,178.89	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Section 2

**Figure 7. Land cover in the Spring River watershed**

3. Applicable Water Quality Standards

TMDLs identify the maximum pollutant load that a water body can assimilate and still attain and maintain water quality standards. Water quality standards are therefore central to the TMDL development process. Under the federal Clean Water Act, every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters (U.S. Code Title 33, Chapter 26, Subchapter III). Water quality standards consist of three major components: designated uses, water quality criteria, and an antidegradation policy. In accordance with federal regulations at 40 CFR 131.10, Missouri's Water Quality Standards for each individual water body also provide for the attainment and maintenance of water quality in any downstream waters.

Revising existing water quality standards is not within the purview of TMDL development. If future water quality monitoring demonstrates that existing water quality standards are not protective of individual water bodies or downstream uses, new water quality standards can be proposed in accordance with the guidance provided in EPA's Water Quality Standards Handbook.¹⁴

3.1 Designated Uses

Missouri's Water Quality Standards at 10 CSR 20-7.031(1)(F) defines designated uses that are assigned to individual water bodies in accordance with 10 CSR 20-7.031(2) and are listed in 10 CSR 20-7.031, Table G (Lakes) and Table H (Streams). Table 5 below lists the designated uses for each impaired stream segment addressed by this TMDL. Spring River tributary (4112) is not listed specifically in 10 CSR 20-7.031 Table H, but the department temporarily assigned the name and WBID for the purpose of assessment, listing on the 2022 303(d) list, and TMDL development. In Missouri's Water Quality Standards, the water body is identified as a Presumed Use Stream and is grouped with all other Presumed Use Streams within the Spring 8-digit HUC, where they share the single WBID 5079. All presumed use streams within the 8-digit HUC share the same designated uses with Spring River tributary (4112) as listed in Table 5, however, neither restorative or protective portions of this TMDL will apply to all Presumed Use Streams within the Spring River watershed as defined in this TMDL.

Table 5. Designated uses of *E. coli* impaired streams in the Spring River watershed

Stream Name	WBID	Designated Uses
Spring River	3160	WWH, CLH, WBC-A, SCR, HHP, IRR, LWP, IND
Dry Hollow Creek	3163	WWH, WBC-B, SCR, HHP, IRR, LWP
Spring River	3164	WWH, CDH, WBC-A, SCR, HHP, IRR, LWP, IND
Spring River	3165	WWH, WBC-A, SCR, HHP, IRR, LWP
Spring River tributary	4112	WWH, WBC-B, SCR, HHP, IRR, LWP
Honey Creek	3169	WWH, WBC-B, SCR, HHP, IRR, LWP
Honey Creek	3170	WWH, WBC-B, SCR, HHP, IRR, LWP
Williams Creek	3171	WWH, CDH, WBC-A, SCR, HHP, IRR, LWP
Williams Creek	3172	WWH, WBC-A, SCR, HHP, IRR, LWP
Truitt Creek	3174	WWH, WBC-B, SCR, HHP, IRR, LWP
Truitt Creek	3175	WWH, SCR, HHP, IRR, LWP
White Oak Creek	3182	WWH, WBC-A, SCR, HHP, IRR, LWP
North Fork Spring River	3186	WWH, WBC-B, SCR, HHP, IRR, LWP
North Fork Spring River	3188	WWH, WBC-B, SCR, HHP, IRR, LWP
Dry Fork	3189	WWH, WBC-A, SCR, HHP, IRR, LWP
Opossum Creek	3190	WWH, WBC-B, SCR, HHP, IRR, LWP
Duval Creek	3199	WWH, WBC-B, SCR, HHP, IRR, LWP

¹⁴ <https://www.epa.gov/wqs-tech/water-quality-standards-handbook>

Stream Name	WBID	Designated Uses
Slater Branch	3754	WWH, WBC-B, SCR, HHP, IRR, LWP

- WWH - Protection and propagation of fish, shellfish, and wildlife – warm water habitat
- CLH - Protection and propagation of fish, shellfish, and wildlife - cool water habitat
- CDH - Protection and propagation of fish, shellfish, and wildlife - cold water habitat
- WBC-A - Whole body contact recreation category A
- WBC-B - Whole body contact recreation category B
- SCR - Secondary contact recreation
- HHP - Human health protection
- IRR - Irrigation
- LWP - Livestock and wildlife protection
- IND - Industrial water supply

For the streams addressed by the restorative portion of this TMDL, the whole body contact recreational designated uses are impaired due to high *E. coli* bacteria concentrations. Additionally, for Truitt Creek (3175), secondary contact recreational use is also impaired due to high concentrations of *E. coli*. Whole body contact recreation includes activities that involve direct human contact with waters of the state to the point of complete body submergence (10 CSR 20-7.031(1)(F)2.A.). During whole body contact activities, such as swimming, accidental ingestion of the water may occur and there is direct contact to sensitive body organs, such as the eyes, ears, and nose. Whole body contact recreation category A applies to waters that have been established by the property owner as public swimming areas and waters with documented existing whole body contact recreation uses by the public (10 CSR 20-7.031(1)(F)2.A.(I)). Whole body contact recreation category B applies to waters designated for whole body contact recreation not contained within category A (10 CSR 20-7.031(1)(F)2.A.(II)). Secondary contact recreation, which includes activities such as boating, fishing, and wading, are activities that may result in contact with the water that is either incidental or accidental and the probability of ingesting appreciable quantities of water is minimal (10 CSR 20-7.031(1)(F)2.B).

3.2 Water Quality Criteria

Water quality criteria represent a level of water quality that supports and protects particular designated uses. Water quality criteria are expressed as specific numeric criteria and as general narrative statements. Missouri's Water Quality Standards (10 CSR 20-7.031(4) and (5)) establish general criteria applicable to all waters of the state at all times and specific criteria applicable to waters contained in 10 CSR 20-7.031, Tables G and H. Specific numeric *E. coli* bacteria criteria are given in Missouri's Water Quality Standards at 10 CSR 20-7.031(5)(C) and Table A1. For whole body contact recreation category A (WBC-A) waters, *E. coli* concentrations during the recreational season (April 1 through October 31) shall not exceed the geometric mean of 126 cfu/100 mL of water. For whole body contact recreation category B (WBC-B) waters, *E. coli* concentrations during the recreational season shall not exceed the geometric mean of 206 cfu/100 mL of water. For secondary contact recreation (SCR) waters, *E. coli* concentrations during the recreational season shall not exceed the geometric mean of 1,134 cfu/100 mL of water. In losing stream segments, *E. coli* concentrations shall not exceed 126 cfu/100 mL as a maximum at any time of year.

3.3 Antidegradation Policy

Missouri’s Water Quality Standards include the EPA “three-tiered” approach to antidegradation and may be found at 10 CSR 20-7.031(3).

Tier 1 – Protects public health, existing instream water uses, and a level of water quality necessary to maintain and protect existing uses. Tier 1 provides the absolute floor of water quality for all waters of the United States. Existing instream water uses are those uses that were attained on or after November 28, 1975, the date of EPA’s first water quality standards regulations related to existing uses.

Tier 2 – Protects and maintains the existing level of water quality where it is better than applicable water quality criteria. Before water quality in Tier 2 waters can be lowered, there must be an antidegradation review consisting of: (1) a finding that it is necessary to accommodate important economic and social development in the area where the waters are located; (2) full satisfaction of all intergovernmental coordination and public participation provisions; and (3) assurance that the highest statutory and regulatory requirements for point sources and best management practices (BMPs) for nonpoint sources are achieved. Furthermore, water quality may not be lowered to less than the level necessary to fully protect the “fishable/swimmable” uses and other existing uses.

Tier 3 – Protects the quality of outstanding national and state resource waters. Such waters are identified in 10 CSR 20-7.031 Tables D and E. There may be no new or increased discharges to these waters and no new or increased discharges to tributaries of these waters that would result in lower water quality.

Waters in which a pollutant is at, near, or exceeds the water quality criteria are considered in Tier 1 status for that pollutant. Therefore, the antidegradation goals for the impaired streams in the Spring River watershed are to restore water quality to levels that meet water quality standards.

4. Defining the Problem

E. coli is defined at 10 CSR 20-1.031(1)(J) as a type of fecal coliform bacteria found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination. Sewage may contain many types of disease-causing organisms (pathogens). In accordance with Missouri’s 2022 Listing Methodology Document, the WBC-A designated use for Spring River (3160, 3164, 3165), Williams Creek (3171, 3172), White Oak Creek (3182), and Dry Fork Creek (3189) are impaired because the geometric means of *E. coli* samples collected during the recreational season were greater than 126 cfu/100 mL in the most recent three years having available data with five or more samples.¹⁵

WBC-B designated use for Spring River tributary (4112), Honey Creek (3169, 3170), Truitt Creek (3174), North Fork Spring River (3186, 3188), Opossum Creek (3190), Duval Creek (3199), and Slater Branch (3754) are impaired because the geometric means of *E. coli* samples collected during the recreational season were greater than 206 cfu/100 mL in the most recent 3 years having available data with 5 or more samples.

¹⁵ Listing Methodology documents are available online at: <https://dnr.mo.gov/document-search/methodology-development-2022-section-303d-list-missouri>

In Truitt Creek (3175) and Dry Hollow Creek (3163), the secondary contact recreation (SCR) designated use criterion of 1,134 cfu/100 mL was also exceeded during the recreational season twice in the most recent 3 years having available data with 5 or more samples.

Data available to support these listings are summarized in Table 6. Figures 8 and 9 show the geometric means of *E. coli* data sampled per each month of the recreational season, April 1 through October 31. Figure 8 shows Spring River (3160) and North Fork Spring River (3188), which are impaired for WBC-A and WBC-B, respectively, and compares them to the 126 cfu/100 ml and 206 cfu/100 ml criteria. Figure 9 shows the Truitt Creek (3175), which is impaired for SCR, geometric means of *E. coli* data sampled per each month of the recreational season compared to the 1,134 cfu/100 mL criteria. Figures depicting geometric means of *E. coli* data sampled per each month of the recreational season for each impaired segment addressed by this TMDL are available in Appendix C, Figures 48C through 62C. Data for recreational seasons having fewer than 5 samples are also presented, but the department did not use this data for making water quality assessment or 303(d) listing decisions. Common months with the highest *E. coli* geomeans are May and June. This correlates with the peak precipitation months as shown in Figure 5 meaning that nonpoint sources, driven by precipitation and runoff, are likely contributing to the impairment.

Individual *E. coli* measurements are provided in Appendix A: *E. coli* Data Report, to illustrate the nature of the impairment but were not used in the calculation of TMDL loading capacities or allocations. Appendix A: *E. coli* Data Report is a large document due to the large number of samples taken in the Spring River watershed over the years. For this reason, the report will be available separately online at: <https://dnr.mo.gov/document-search/all-available-e-coli-sample-data-spring-river-watershed-tmdl>. Individual measurements can be used to estimate pollutant reduction targets, to target implementation activities, and to select appropriate BMPs. Reduction targets are provided in Appendix E.

Table 6. Summary of available *E. coli* data for the impaired streams in the Spring River watershed

Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Spring River (3160)	2022	3	10.0	20.0	15.9
	2021	2	31.0	96.0	54.6
	2020	117	27.9	4,839.2	110.9
	2019	73	12.0	6,867.0	318.7
	2018	133	17.9	4,839.2	140.0
	2017	137	15.0	4,839.2	195.6
	2016	125	24.5	4,839.2	165.0
	2015	138	31.8	4,839.2	263.8
	2014	135	2.0	4,839.2	99.3
	2013	129	31.0	4,839.2	188.2
	2012	150	16.1	3,800.0	100.4
	2011	43	8.0	1,200.0	66.1
	2010	192	13.7	7,100.0	156.1
	2009	139	20.0	4,839.2	226.5
	2008	157	10.0	4,839.2	186.9
	2007	225	5.0	4,840.0	252.8
	2006	121	9.0	2,429.0	190.9
	2005	73	30.0	2,420.0	139.6

	2004	7	5.0	270.0	52.5
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Dry Hollow Creek (3163)	2023	1	81.3	81.3	81.3
	2022	5	83.3	4839.2	623.7
	2021	5	137.6	1413.6	398.6
	2020	5	122.3	248.9	174.0
	2012	5	1.0	4839.2	11.9
	2011	11	4.1	686.7	56.8
	2010	12	9.7	4839.2	338.5
	2007	6	206.0	4840.0	1250.6
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Spring River (3164)	2023	5	248.1	1,299.7	518.6
	2013	2	755.6	4,839.2	1,912.2
	2012	4	15.6	2,419.6	101.2
	2011	36	17.5	1,413.6	216.6
	2010	42	81.6	4,839.2	853.1
	2007	9	43.0	4,840.0	437.0
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Spring River (3165)	2023	5	209.8	1,413.6	394.3
	2013	2	214.2	285.1	247.1
	2012	4	11.6	4,839.2	70.5
	2011	50	12.2	2,419.6	175.0
	2010	60	27.9	4,839.2	269.9
	2008	8	26.0	1,733.0	139.9
	2007	6	5.0	770.0	32.1
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Spring River tributary (4112)	2011	28	20.1	2,419.6	153.1
	2010	13	8.4	2,419.6	196.8
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Honey Creek (3169)	2023	5	172.2	770.1	409.8
	2013	2	167.9	686.7	339.6
	2012	3	88.6	4,839.2	947.9
	2011	11	13.7	2,419.6	342.0
	2010	12	142.1	4,839.2	803.3
	2008	7	101.0	1,553.0	379.5
	2007	1	172.0	172.0	172.0
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Honey Creek	2023	5	186.0	4,839.2	744.8

(3170)	2013	2	574.8	1,203.3	831.7
	2010	1	613.1	613.1	613.1
	2007	12	44.0	4,840.0	881.6
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Williams Creek (3171)	2023	5	108.6	279.5	183.3
	2015	7	6.3	732.6	85.5
	2007	6	38	2,420.0	205.6
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Williams Creek (3172)	2023	5	41.4	686.7	109.9
	2015	36	60.9	4,839.2	1,224.4
	2013	2	282.1	4,839.2	1,168.4
	2012	4	60.9	4,839.2	226.4
	2011	6	105.0	980.4	271.3
	2010	7	129.6	1,986.3	664.8
	2008	4	93.0	2,420.0	531.7
	2007	8	260.0	4,840.0	1,353.5
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Truitt Creek (3174)	2023	5	866.4	1,413.6	1,125.4
	2014	7	151.0	4,839.2	1,090.6
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Truitt Creek (3175)	2023	5	866.4	2,419.6	1,251.3
	2014	7	228.2	4,839.2	1,779.1
	2013	2	574.8	4,839.2	1,667.8
	2012	4	4839.2	4,839.2	4,839.2
	2011	6	613.1	4,839.2	2,446.3
	2010	7	727.0	4,839.2	2,306.0
	2008	5	488.0	4,840.0	1,116.0
	2007	4	1553.0	4,840.0	2,817.8
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
White Oak Creek (3182)	2011	14	15.8	1,986.3	147.3
	2010	9	4.0	1,413.6	69.1
	2007	11	105.0	1,300.0	373.6
	2011	14	15.8	1,986.3	147.3
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
North Fork Spring River (3186)	2020	18	18.7	4,839.2	153.4
	2019	9	139.6	4,839.2	696.8
	2018	18	6.3	4,839.2	130.6
	2017	19	26.2	4,839.2	308.4
	2016	17	21.8	4,839.2	201.7
	2015	19	77.1	4,839.2	268.5

	2014	18	5.2	4,839.2	53.3
	2013	17	51.2	1,986.3	222.2
	2012	21	0.0	1,119.9	35.2
	2010	20	15.8	2,419.6	121.7
	2007	25	38.9	4,840.0	289.5
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
North Fork Spring River (3188)	2020	18	71.7	1,299.7	293.7
	2019	9	137.4	4,839.2	870.1
	2018	18	63.7	4,839.2	378.0
	2017	38	41.0	4,839.2	551.2
	2016	62	23.8	4,839.2	217.9
	2015	53	8.5	4,839.2	246.4
	2014	52	8.4	4,839.2	91.0
	2013	57	22.6	4,839.2	236.7
	2012	58	1.0	4,839.2	124.4
	2011	58	13.1	4,839.2	199.0
	2010	68	3.1	4,839.2	110.2
	2007	20	82.6	4,840.0	345.0
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Dry Fork (3189)	2020	18	45	1,986.3	201.7
	2019	9	137.6	4,839.2	397.0
	2018	18	31.3	2,419.6	226.8
	2017	19	40.5	1,413.6	212.6
	2016	17	46.5	1,203.3	227.0
	2015	19	101.7	4,839.2	513.8
	2014	18	22.8	4,839.2	106.6
	2013	17	58.6	4,839.2	255.2
	2012	20	5.2	4,839.2	87.8
	2011	28	1.0	2,419.6	54.8
	2010	33	7.3	4,839.2	83.3
	2007	20	148.3	4,840.0	488.3
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Opossum Creek (3190)	2016	6	78.9	4,839.2	227.8
	2015	13	31.7	1,119.9	245.3
	2014	2	45.7	122.3	74.8
	2011	28	16.9	1,986.3	147.3
	2010	13	22.8	4,839.2	142.6
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Duval Creek (3199)	2011	12	46.8	4,839.2	792.4
	2010	9	21.6	4,839.2	173.7
Waterbody (WBID)	Year	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean* (cfu/100 mL)
Slater Branch	2011	13	56.5	980.4	274.4

(3754)	2010	13	29.5	727.0	131.7
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* Although geometric means are presented for all years of available data, only years with a minimum of five samples were used for assessment purposes. For calculation purposes, and for consistency with Missouri's 303(d) listing methodologies, *E. coli* values recorded as greater-than (>) values were doubled and values recorded as less-than (<) values were halved.

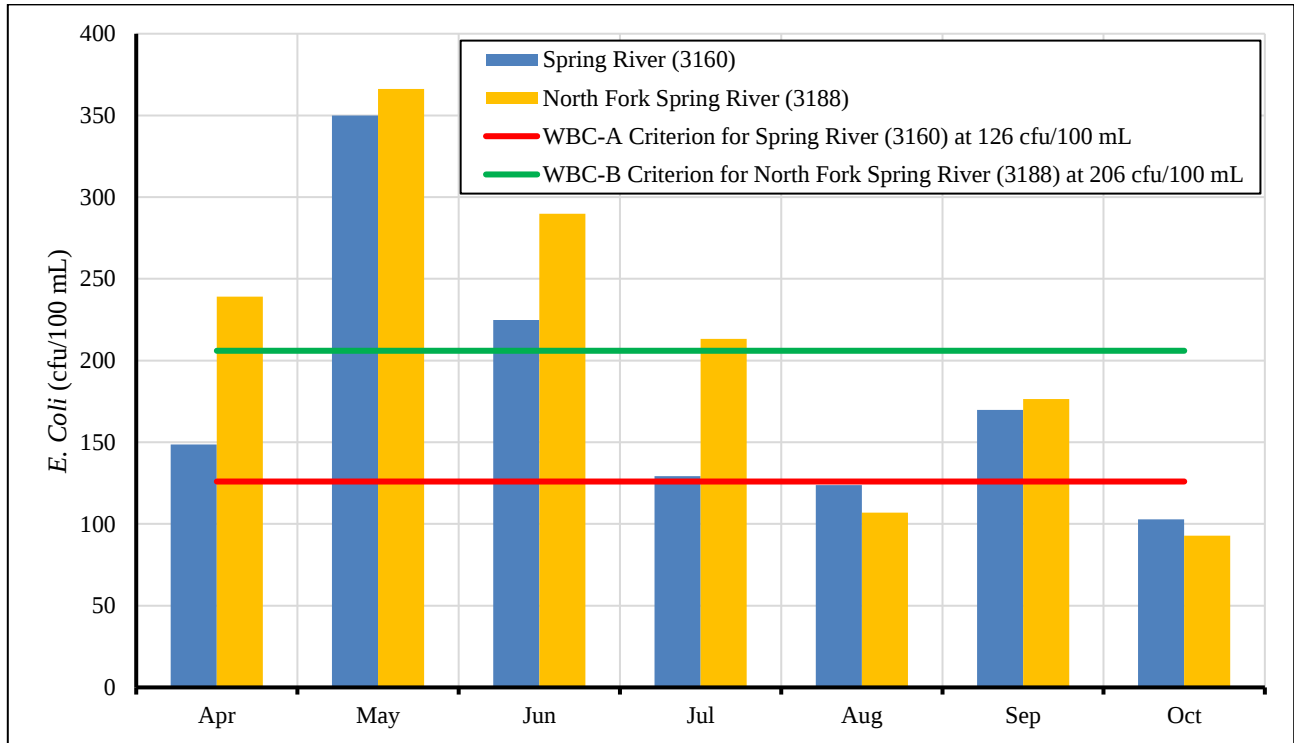


Figure 8. Geometric means of *E. coli* samples by month from 2004-2022 in Spring River (3160) and 2007, 2010-2020 in North Fork Spring River (3188)

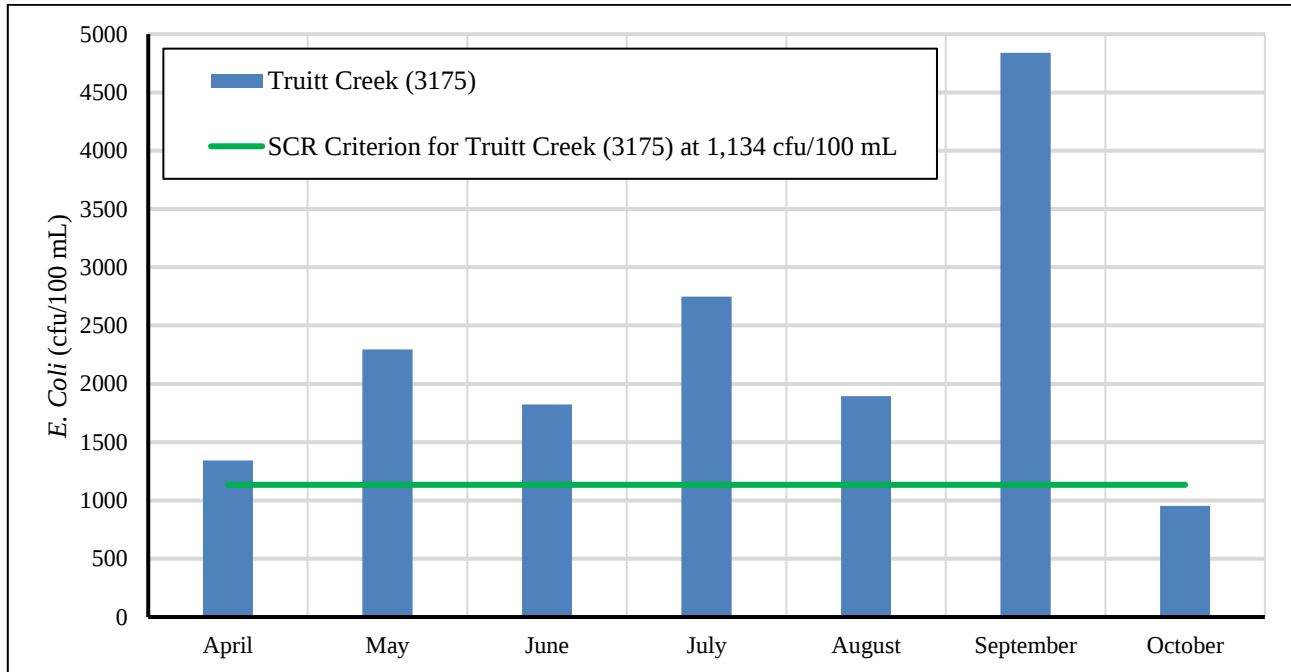


Figure 9. Geometric means for *E. coli* samples by month from years 2007, 2008, 2010-2014, and 2023 in Truitt Creek (3175)

5. Source Inventory and Assessment

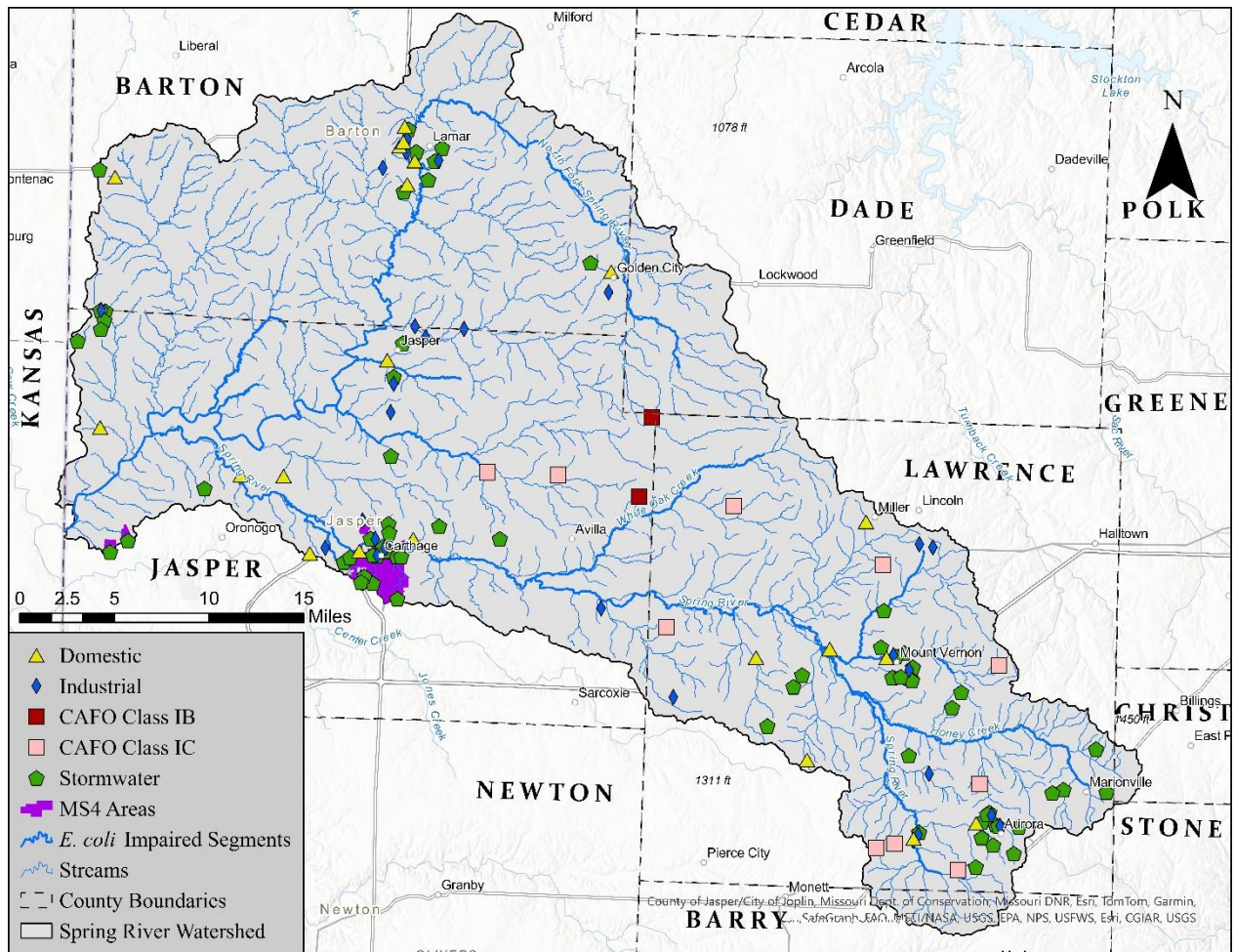
Point (typically regulated) and nonpoint (typically unregulated) sources may contribute to the elevated *E. coli* concentrations in the impaired water bodies. The following source inventory and assessment identifies and characterizes known, suspected, and potential sources of bacteria loading in the Spring River watershed. Sources of bacteria loading are identified and quantified to the extent that information is available.

5.1 Point Sources

Point sources are defined by Section 644.016(16) of the Missouri Clean Water Law and are regulated pursuant to the National Pollutant Discharge Elimination System (NPDES) through the Missouri State Operating Permit program.¹⁶ A point source is defined as “any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. Point source does not include agricultural stormwater discharges and return flows from irrigated agriculture.” Based on this definition, point sources include domestic wastewater treatment facilities, industrial facilities, concentrated animal feeding operations (CAFOs), municipal separate storm sewer systems (MS4s), and stormwater discharges from industrial areas and construction sites. Illicit straight pipe discharges are also point sources but are illegal and therefore unpermitted. Pollutant loading from point sources is typically most evident during low-flow conditions when stormwater influences are lower or nonexistent. The locations of permitted point sources in the Spring River watershed are

¹⁶ The Missouri State Operating Permit program is Missouri’s program for administering the federal National Pollutant Discharge Elimination System (NPDES). Generally, the Clean Water Act requires all point sources that discharge pollutants to waters of the United States to obtain a NPDES permit. Issued and proposed operating permits are available online at: dnr.mo.gov/water/business-industry-other-entities/permits-certification-engineering-fees.

presented in Figure 10. Facility types and their expected contributions to the impaired stream are described individually in the following sections.

Figure 10. Permitted outfalls in the Spring River watershed¹⁷

5.1.1 Domestic Wastewater Treatment Facilities

Domestic wastewater is primarily household waste, including graywater and sewage. Domestic wastewater treatment facilities include both publicly owned (municipal and sewer districts) and privately owned facilities. Untreated or inadequately treated domestic wastewater discharges can be significant sources of bacteria to receiving waters (USEPA 1986). For this reason, domestic wastewater treatment facilities are potential sources of *E. coli* loading to the Spring River. However, when operating as designed, facilities utilizing disinfection technologies discharge *E. coli* at very low concentrations and are not expected to cause or contribute to bacteria impairments through discharges of treated effluent. Facilities that use effluent for irrigation (land application) or otherwise do not directly discharge to streams during the recreational season are also not expected to cause or contribute to *E. coli* impairments when all permit conditions are met.

Table 7 lists the domestic wastewater dischargers in the Spring River watershed. 10 CSR 20-7.015 requires recreational season *E. coli* limits for all domestic wastewater treatment facilities within two

¹⁷ Each marker on the map represents a facility. There may be multiple outfalls per facility.

miles upstream of waters with whole body contact designated uses. Facilities without disinfection can be potential sources of *E. coli* loading if not operated in a manner to mitigate significant *E. coli* loading during the recreational season. Facilities with disinfection generally do not contribute significant *E. coli* loading under normal operating conditions. Efforts to reduce facility loading to meet newly established wasteload allocations and to comply with applicable recreational criteria may include, but are not limited to, installation of disinfection infrastructure, effluent land application or irrigation, pump and haul operations, and seasonal batch discharging. Some discharging lagoon systems do not discharge during dry conditions and are therefore less likely to cause or contribute to the existing impairment.

There are four general domestic wastewater permitted facilities within the watershed. One MOGDS, two MOG823, and one MOG821. MOGDS general permits are for domestic wastewater facilities discharging less than or equal to 50,000 gallons per day to streams. MOG823 general permits are for land application of domestic wastewater and MOG821 are for land application of domestic wastewater biosolids. These land application facilities are no discharge permits and are the only domestic facilities in the watershed without *E. coli* limits. If all permit conditions are met, then these facilities are not expected to contribute *E. coli* to the impaired water body.

The Freistatt WWTF (MO0109274) does not discharge to surface waters, instead the facility disinfects wastewater before using it for irrigation. If all permit conditions are met, the facility is not expected to cause or contribute to the *E. coli* impairments.

Table 7. Permitted Domestic wastewater treatment facilities in the Spring River watersheds

Spring River (3160)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft ³ /s)	Disinfection	Expires (M/D/Y) ¹⁸
MO0089036	Alba WWTP	Mechanical Plant	0.155	Ultraviolet	3/31/2023
MO0114740	Asbury WWTF	Lagoon	0.028	None	9/30/2028
MO0036757	Aurora WWTP	Mechanical Plant	3.094	Ultraviolet	3/31/2030
MOGDS0076	Baptist Hill Camp WWTF	Sand/Rock Filter	0.023	None	6/30/2029
MO0034410	Blue Top Motel and Cafe	Lagoon	0.015	None	3/31/2023
MO0039136	Carthage WWTP	Mechanical Plant	10.831	Ultraviolet	3/31/2023
MO0109274	Freistatt WWTF	Land Application	0.036	None	6/30/2023
MO0031658	Golden City WWTF	Mechanical Plant	0.480	Ultraviolet	12/31/2028
MOG821008	Hillbilly Pumping and Hauling Inc	Land Application	0	None	11/30/2027
MO0044202	Jasper WWTF	Lagoon	0.209	Ultraviolet	3/31/2028
MOG823015	Jerry Marti	Land Application	0.005	None	8/24/2027
MO0044172	Lamar WWTF	Lagoon	1.191	Ultraviolet	3/31/2023
MOG823035	Leggett and Platt	Lagoon	0	None	8/24/2027
MO0096270	Living Word Estates WWTP	Mechanical Plant	0.008	Ultraviolet	5/31/2028
MO0023159	Marionville WWTP	Mechanical Plant	0.774	Ultraviolet	9/30/2022
MO0129755	MAWC, Purcell WWTF	Sand/Rock Filter	0.067	Ultraviolet	12/31/2022
MO0041149	Miller WWTF	Lagoon	0.116	None	9/30/2022
MO0116581	Mindenmines WWTF	Lagoon	0.062	None	12/31/2027

¹⁸ Expired permits are administratively continued until the permit renewal process is completed. The permittee is obligated to adhere to all permit conditions even while the permit is expired.

MO0022381	Mount Vernon WWTP	Mechanical Plant	2.089	Ultraviolet	3/31/2023
MO0115321	Stotts City WWTP	Sand/Rock Filter	0.039	Ultraviolet	1/31/2029
MO0124541	Sunset mobile home park WWTF	Sand/Rock Filter	0.011	Chlorination	9/30/2022
MO0120456	Super 8 Lamar WWTP	Sand/Rock Filter	0.009	Ultraviolet	5/31/2028
MO0092525	Verona WWTP	Mechanical Plant	0.165	Ultraviolet	3/31/2023
Dry Hollow Creek (3163)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft³/s)	Disinfection	Expires (M/D/Y)
MO0115321	Stotts City WWTP	Sand/Rock Filter	0.039	Ultraviolet	1/31/2029
Spring River (3164)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft³/s)	Disinfection	Expires (M/D/Y)
MO0036757	Aurora WWTP	Mechanical Plant	3.094	Ultraviolet	3/31/2023
MOGDS0076	Baptist Hill Camp WWTF	Sand/Rock Filter	0.023	None	6/30/2029
MO0109274	Freistatt WWTF	Land Application	0.036	None	6/30/2023
MO0023159	Marionville WWTP	Mechanical Plant	0.774	Ultraviolet	9/30/2022
MO0022381	Mount Vernon WWTP	Mechanical Plant	2.089	Ultraviolet	3/31/2023
MO0092525	Verona WWTP	Mechanical Plant	0.165	Ultraviolet	3/31/2023
Spring River (3165)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft³/s)	Disinfection	Expires (M/D/Y)
MO0036757	Aurora WWTP	Mechanical Plant	3.094	Ultraviolet	3/31/2023
MO0092525	Verona WWTP	Mechanical Plant	0.165	Ultraviolet	3/31/2023
Spring River trib. (4112)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft³/s)	Disinfection	Expires (M/D/Y)
MOG823035	Leggett and Platt	Lagoon	0.000	None	8/24/2027
Honey Creek (3169)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft³/s)	Disinfection	Expires (M/D/Y)
MO0023159	Marionville WWTP	Mechanical Plant	0.774	Ultraviolet	9/30/2022
Honey Creek (3170)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft³/s)	Disinfection	Expires (M/D/Y)
MO0023159	Marionville WWTP	Mechanical Plant	0.774	Ultraviolet	9/30/2022
Williams Creek (3171)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft³/s)	Disinfection	Expires (M/D/Y)
MOGDS0076	Baptist Hill Camp WWTF	Sand/Rock Filter	0.023	None	6/30/2029
MO0022381	Mount Vernon WWTP	Mechanical Plant	2.089	Ultraviolet	3/31/2023
Williams Creek (3172)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft³/s)	Disinfection	Expires (M/D/Y)
MO0022381	Mount Vernon WWTP	Mechanical Plant	2.089	Ultraviolet	3/31/2023
North Fork Spring River (3186)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft³/s)	Disinfection	Expires (M/D/Y)
MO0089036	Alba WWTP	Mechanical Plant	0.155	Ultraviolet	3/31/2023
MO0034410	Blue Top Motel and Cafe	Lagoon	0.015	None	3/31/2023
MO0031658	Golden City WWTF	Mechanical Plant	0.480	Ultraviolet	12/31/2028

MOG821008	Hillbilly Pumping and Hauling Inc	Land Application	0	None	11/30/2027
MO0044202	Jasper WWTF	Lagoon	0.209	Ultraviolet	3/31/2028
MOG823015	Jerry Marti	Land Application	0.005	None	8/24/2027
MO0044172	Lamar WWTF	Lagoon	1.191	Ultraviolet	3/31/2023
MO0096270	Living Word Estates WWTP	Mechanical Plant	0.008	Ultraviolet	5/31/2028
MO0116581	Mindenmines WWTF	Lagoon	0.062	None	12/31/2027
MO0120456	Super 8 Lamar WWTP	Sand/Rock Filter	0.009	Ultraviolet	5/31/2028
North Fork Spring River (3188)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft ³ /s)	Disinfection	Expires (M/D/Y)
MO0034410	Blue Top Motel and Cafe	Lagoon	0.015	None	3/31/2023
MO0031658	Golden City WWTF	Mechanical Plant	0.480	Ultraviolet	12/31/2028
MO0044202	Jasper WWTF	Lagoon	0.209	Ultraviolet	3/31/2028
MOG823015	Jerry Marti	Land Application	0.005	None	8/24/2027
MO0044172	Lamar WWTF	Lagoon	1.191	Ultraviolet	3/31/2023
MO0096270	Living Word Estates WWTP	Mechanical Plant	0.008	Ultraviolet	5/31/2028
MO0120456	Super 8 Lamar WWTP	Sand/Rock Filter	0.009	Ultraviolet	5/31/2028
Opossum Creek (3190)					
Permit No.	Facility Name	Treatment Type	Design Flow (ft ³ /s)	Disinfection	Expires (M/D/Y)
MO0044202	Jasper WWTF	Lagoon	0.209	Ultraviolet	3/31/2028

Nine Wastewater Treatment Facilities (WWTF) within the Spring River watershed, outlined in Table 8, have had instances of non-compliance that could have impacted water quality over the last 15 years. While not all issues of non-compliance cause or contribute to the *E. coli* impairment, some instances including exceeding permit limit and causing pollution to waters of the state can potentially contribute to the impairment. The department's Clean Water Compliance and Enforcement section is currently overseeing active cases with the goal of returning the facilities back to compliance. Following approval of this TMDL, permit limits for all facilities will need to meet any new permit limits after wasteload allocations are calculated, the TMDL is approved, and must be consistent with the assumptions and requirements of available wasteload allocations. Permit limits to incorporate TMDL allocations are typically changed included at the next permit renewal.

Table 8. Compliance issues from 2009 to 2024 for domestic WWTFs within the Spring River watersheds¹⁹

Permit No.	Period Under Enforcement	Violation(s)	Primary Receiving Impaired Waterbody
MO0089036	12/21/2009 - 2/4/2020	failure to operate and maintain WW facility	North Fork Spring River (3186)
MO0034410	8/2/2011 – Present	failure to operate and maintain WW facility, failure to upgrades facilities	North Fork Spring River (3188)

¹⁹ The list of violations listed is not exhaustive and only includes those with the potential to cause or contribute to the *E. coli* impairment.

MO0082767	6/10/2015 - 11/22/2019	caused pollution to waters of the state	Spring River (3160)
MO0031658	3/9/2011 - 2/16/2016	failure to upgrade facilities	North Fork Spring River (3188)
MO0044202	10/1/2021 - Present	failure to meet permit limits	Opossum Creek (3190)
	2/18/1999 - 9/22/2016	caused pollution to waters of the state, failure to meet permit limits	
MO0041149	7/15/2019 - Present	failure to meet permit limits	Spring River (3160)
MO0124541	2/25/2016 - Present	caused pollution to waters of the state, failure to operate and maintain wastewater facility, violated effluent requirements	Spring River (3160)

In addition to issues of non-compliance outlined in Table 8, domestic wastewater treatment facilities may also contribute bacteria loading from sanitary sewer overflows (SSOs). Sanitary sewer systems convey residential wastewater, and in some cases industrial wastewater, to the domestic wastewater treatment facility. Sanitary sewer systems can handle limited amounts of inflow from stormwater and infiltration from groundwater but are typically not designed to collect large amounts of runoff from precipitation events. Overflows from sanitary sewer systems may result in elevated bacteria counts in nearby surface waters (USEPA 1996). Sanitary sewer overflows can be caused by high volume precipitation events and can also occur during dry weather due to blockages, line breaks, sewer defects, power failures, and vandalism. Sanitary sewer overflows can occur at any point in the collection system but are typically evident by overflowing manholes and backups into private residences. Such overflows may discharge directly to nearby waterways or may be restricted to terrestrial locations. These discharges are not authorized by the federal Clean Water Act or the Missouri Clean Water Law.

Approximately 408 SSO or bypass events have been reported to the department within the Spring River watershed over the time span of April 1, 2004, through October 31, 2023. This time frame was queried to cover the full range sample data shown in Appendix A: *E. coli* Data Report. Municipalities with significant SSO reporting include Carthage WWTF (MO0039136) with 247 events, Miller WWTF (MO0041149) reporting approximately 33 events, and Mount Vernon WWTP (MO0022381) reporting 32 events. While these events can be potential sources of *E. coli*, not all events reach surface waters or are significant in discharge volume. Missouri State Operating permits, and 40 CFR Part 122.41(e) require permittees to properly operate and maintain their facility's collection systems. This is implemented through a special permit condition or schedule of compliance.

Following approval of this TMDL, permit limits for all facilities must be consistent with the assumptions and requirements of available wasteload allocations. Permit limits to incorporate TMDL allocations are typically included at the next permit renewal.

5.1.2 Industrial Permitted Facilities

Industrial facilities discharge process and non-process wastewater used or generated during mining, manufacturing, or food processing activities, and may also include landfills, and land application sites. Table 9 provides facility details for the 10 site-specific and 21 general industrial permitted facilities in the Spring River watershed.

There are two general permits in the MOG22 category issued for small meat processing facilities, Triple E Processing (MOG220031) and Dean Troyer (MOG220124). Facilities under MOG22 general permits are no discharge and are required to land apply excess lagoon freeboard therefore if a facility meets all requirements of the relevant subdivision in the master general permit for small meat processors, it should not cause or contribute to the *E. coli* impairments in the Spring River watershed.

There is one MOG822 general permit for land application of food processing wastewater issued to Hillbilly Pumping and Hauling Inc (MOG822182). Because this facility does not discharge directly to surface waters, when all permit conditions are met, this facility is not expected to contribute *E. coli* loads to water bodies.

The remaining 18 general permits are for industrial operations that are not expected to be a source of *E. coli*. The industrial activities for these general permits include oil/water separators, heat pumps, petroleum storage <250,000 gallons, limestone quarries, water treatment plant settling basins, car washes, and petroleum impacted water remediation.

Of the 10 site-specific industrial permitted facilities in the Spring River watershed, only one has the potential to cause or contribute to the impairment.

Asbury Renewable Operations Center (MO0095362) discharges stormwater to Tributary to Blackberry Creek (5079) from ash ponds, reclaimed coal pile areas, and power plant demolition. Domestic waste is handled with an on-site no-discharge lagoon with sub-surface lateral field. If all permit conditions are met this facility is not expected to contribute *E. coli* loads above negligible amounts to the water body.

BCP Ingredients, Inc (MO0002356) discharges stormwater and non-contact cooling water to Spring River (3165). This facility does not generate *E. coli* and is not expected to contribute *E. coli* loads above negligible amounts to the water body.

Butterball, LLC (MO0082767) is a turkey processing plant that discharges stormwater from feed mill parking lots and live poultry sheds to Spring River (3160) from Outfalls #002 and #004. Outfall #003 discharges stormwater from truck transportation areas, parking runoff and processing plant partial site stormwater. The first inch of precipitation that discharges through Outfall #003 is captured and sent to City of Carthage WWTF for pretreatment. During rain events beyond one inch of rainfall, excess runoff is discharged through the outfall to Spring River (3160). The three outfalls have a combined final effluent limit set for *E. coli*. This facility has the potential to contribute *E. coli* loads to the water body and discharge monitoring report (DMR) data show that on occasion this facility is contributing *E. coli* loads.

Empire - Energy Center – Sarcoxie (MO0116874) discharges reverse osmosis reject water and incidental stormwater to Tributary to Cave Spring Branch. The facility also land applies wastewater to provide hydraulic support to vegetation. This facility is not expected to generate or contribute *E. coli* loads to the water body.

IsoNova Technologies LLC (MO0112500) provides inedible egg product for pet foods. The facility is a no-discharge wastewater storage and land application system. During periods of inclement

weather wastewater is hauled to Springfield WWTF or removed by a permitted contract hauler. For these reasons, this facility is not expected to contribute *E. coli* loads to the water body.

Kemin Industries, Inc. (MO0136760) receives raw meat and processes it into dried protein powder for animal feed supplements. The facility discharges stormwater to Tributary to Spring River through seven outfalls, and stores industrial wastewater in a no-discharge aerated earthen basin. Industrial wastewater is land applied. This facility is not expected to contribute *E. coli* loads above negligible amounts to the water body.

Lamar Closed Sanitary Landfill (MO0110272) is a capped landfill that has been closed for use since 1984. The facility discharges industrial stormwater to Tributary to Dick's Fork but the leachate is stored in a no-discharge holding pond. When needed, the holding pond is pumped, and leachate is hauled to a WWTF for treatment. The facility is not expected to contribute *E. coli* loads above negligible amounts to the water body.

Lamarti's Truck Stop (MO0138592) handles domestic wastewater, car/truck wash wastewater, fast food kitchen wastewater, and wastewater flows from 4 other adjacent businesses in an earthen basin. The permit allows a non-discharging lagoon with land application fields and therefore is not expected to contribute *E. coli* loads to the water body when all permit conditions are met.

Missouri and Northern Arkansas Railroad (MO0139947) is a locomotive maintenance, fueling, and washing facility that discharges industrial stormwater to Tributary to Spring River. This facility does not generate *E. coli* and therefore is not expected to contribute *E. coli* loads above negligible amounts to the water body.

Phillips 66 Mount Vernon Terminal (MO0106861) is a petroleum bulk storage and terminal that discharges hydrostatic testing wastewater to Tributary to Truitt Creek. Domestic wastewater is sent to an off-site permitted wastewater treatment facility, but the facility also has the option to use a sub-surface distribution system for domestic waste which is has the potential to be used by more than 20 persons per day. The facility's sub-surface system (inventory number MOS010950049) is currently registered as an underground injection control (UIC) as a Class V well for domestic waste with the department's Geospatial Survey Program. If all permit conditions are met this facility is not expected to contribute *E. coli* loads above negligible amounts to the water body.

Table 9. Industrial permitted facilities in the Spring River watershed

Spring River (3160)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y) ²⁰
MOG251003	Allergon	Heat Pumps	12/31/2026
MO0095362	Asbury Renewable Operations Center	Electric Services	3/31/2027
MO0002356	BCP Ingredients, Inc.	Prepared Feeds	3/31/2023
MOG490765	Blevins Asphalt Construction Co Inc	Limestone Quarries	4/30/2027
MO0082767	Butterball, LLC	Poultry Slaughtering and Processing	3/31/2023
MOG490244	Carthage Crushed Limestone	Limestone Quarries	4/30/2027
MOG490349	Coastal Emulsions of Missouri	Limestone Quarries	4/30/2027
MOG220124	Dean Troyer	Small Meat Processors	6/30/2027

²⁰ Expired permits are administratively continued until the permit renewal process is completed. The permittee is obligated to adhere to all permit conditions even while the permit is expired.

MO0116874	Empire - Energy Center - Sarcoxie	Electric Services	4/30/2028
MOG750049	Exit 33 LLC	Car Wash	3/4/2029
MOG350350	Fuel Marketing Corp Jasper Facility	Petroleum Storage (<250,000 gallons)	9/17/2027
MOG490944	G and H Redi-Mix Lamar	Limestone Quarries	4/30/2027
MOG822182	Hillbilly Pumping and Hauling Inc	Land Application of Food Processing Wastewater	5/31/2027
MOG491162	Iowa Limestone Company	Limestone Quarries	4/30/2027
MO0112500	IsoNova Technologies LLC	Poultry Slaughtering and Processing	9/30/2022
MOG490063	Jasper Quarry	Limestone Quarries	4/30/2027
MOG491139	Jasper Quarry	Limestone Quarries	4/30/2027
MOG490620	Kay Concrete Materials Co Mount Vernon	Limestone Quarries	4/30/2027
MOG490619	Kay Concrete Materials Company Aurora	Limestone Quarries	4/30/2027
MO0136760	Kemin Industries, Inc.	Poultry Slaughtering and Processing	3/31/2023
MO0110272	Lamar Closed Sanitary Landfill	Refuse Systems	9/30/2022
MOG640014	Lamar DWTP	Water Treatment Plant Settling Basins	2/24/2029
MO0138592	Lamarti's Truck Stop	Grocery Stores	5/31/2026
MOG350157	MFA Oil Bulk Plant Aurora	Petroleum Storage (<250,000 gallons)	9/17/2027
MOG350161	MFA Oil Bulk Plant Golden City	Petroleum Storage (<250,000 gallons)	9/17/2027
MOG350160	MFA Oil Bulk Plant Jasper	Petroleum Storage (<250,000 gallons)	9/17/2027
MO0139947	Missouri and Northern Arkansas Railroad	Fueling and Maintenance	8/31/2028
MOG940249	Petro Card 24	Petroleum Impacted Water Remediation	8/31/2027
MO0106861	Phillips 66 Mount Vernon Terminal	Petroleum Bulk Stations and Terminals	8/31/2028
MOG140075	Travel Centers of America	Oil/Water Separators	6/30/2029
MOG220031	Triple E Processing	Small Meat Processors	6/30/2027
Spring River (3164)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MO0002356	BCP Ingredients, Inc.	Prepared Feeds	3/31/2023
MO0112500	IsoNova Technologies LLC	Poultry Slaughtering and Processing	9/30/2022
MOG490620	Kay Concrete Materials Co Mount Vernon	Limestone Quarries	4/30/2027
MOG490619	Kay Concrete Materials Company Aurora	Limestone Quarries	4/30/2027
MO0136760	Kemin Industries, Inc.	Poultry Slaughtering and Processing	3/31/2023
MOG350157	MFA Oil Bulk Plant Aurora	Petroleum Storage (<250,000 gallons)	9/17/2027
MOG940249	Petro Card 24	Petroleum Impacted Water Remediation	8/31/2027
MOG140075	Travel Centers of America	Oil/Water Separators	6/30/2029
MOG220031	Triple E Processing	Small Meat Processors	6/30/2027
MO0106861	Phillips 66 Mount Vernon Terminal	Petroleum Bulk Stations and Terminals	8/31/2028

Spring River (3165)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MO0002356	BCP Ingredients, Inc.	Prepared Feeds	3/31/2023
MO0112500	IsoNova Technologies LLC	Poultry Slaughtering and Processing	9/30/2022
MOG490619	Kay Concrete Materials Company Aurora	Limestone Quarries	4/30/2027
MO0136760	Kemin Industries, Inc.	Poultry Slaughtering and Processing	3/31/2023
MOG220031	Triple E Processing	Small Meat Processors	6/30/2027
Spring River trib. (4112)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOG251003	Allergon	Heat Pumps	12/31/2026
Honey Creek (3169)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOG350157	MFA Oil Bulk Plant Aurora	Petroleum Storage (<250,000 gallons)	9/17/2027
MOG940249	Petro Card 24	Petroleum Impacted Water Remediation	8/31/2027
Williams Creek (3171)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOG490620	Kay Concrete Materials Co Mount Vernon	Limestone Quarries	4/30/2027
MO0106861	Phillips 66 Mount Vernon Terminal	Petroleum Bulk Stations and Terminals	8/31/2028
MOG140075	Travel Centers of America	Oil/Water Separators	6/30/2029
Williams Creek (3172)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOG490620	Kay Concrete Materials Co Mount Vernon	Limestone Quarries	4/30/2027
MO0106861	Phillips 66 Mount Vernon Terminal	Petroleum Bulk Stations and Terminals	8/31/2028
MOG140075	Travel Centers of America	Oil/Water Separators	6/30/2029
Truitt Creek (3174)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MO0106861	Phillips 66 Mount Vernon Terminal	Petroleum Bulk Stations and Terminals	8/31/2028
Truitt Creek (3175)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MO0106861	Phillips 66 Mount Vernon Terminal	Petroleum Bulk Stations and Terminals	8/31/2028
North Fork Spring River (3186)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOG350350	Fuel Marketing Corp Jasper Facility	Petroleum Storage (<250,000 gallons)	9/17/2027
MOG490944	G and H Redi-Mix Lamar	Limestone Quarries	4/30/2027
MOG491162	Iowa Limestone Company	Limestone Quarries	4/30/2027
MOG491139	Jasper Quarry	Limestone Quarries	4/30/2027
MOG490063	Jasper Quarry	Limestone Quarries	4/30/2027
MO0110272	Lamar Closed Sanitary Landfill	Refuse Systems	9/30/2022
MOG640014	Lamar Municipal DWTP	Water Treatment Plant Settling Basins	2/24/2029
MO0138592	Lamarti's Truck Stop	Grocery Stores	5/31/2026
MOG350161	MFA Oil Bulk Plant Golden City	Petroleum Storage (<250,000 gallons)	9/17/2027

MOG350160	MFA Oil Bulk Plant Jasper	Petroleum Storage (<250,000 gallons)	9/17/2027
North Fork Spring River (3188)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOG490944	G and H Redi-Mix Lamar	Limestone Quarries	4/30/2027
MOG491162	Iowa Limestone Company	Limestone Quarries	4/30/2027
MOG490063	Jasper Quarry	Limestone Quarries	4/30/2027
MOG491139	Jasper Quarry	Limestone Quarries	4/30/2027
MO0110272	Lamar Closed Sanitary Landfill	Refuse Systems	9/30/2022
MOG640014	Lamar DWTP	Water Treatment Plant Settling Basins	2/24/2029
MO0138592	Lamarti's Truck Stop	Grocery Stores	5/31/2026
MOG350161	MFA Oil Bulk Plant Golden City	Petroleum Storage (<250,000 gallons)	9/17/2027
MOG350160	MFA Oil Bulk Plant Jasper	Petroleum Storage (<250,000 gallons)	9/17/2027
Dry Fork (3189)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOG350350	Fuel Marketing Corp Jasper Facility	Petroleum Storage (<250,000 gallons)	9/17/2027
Opossum Creek (3190)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOG350160	MFA Oil Bulk Plant Jasper	Petroleum Storage (<250,000 gallons)	9/17/2027

5.1.3 Concentrated Animal Feeding Operations

Animal waste generated from CAFOs can be a source of bacteria to water bodies (Rogers & Haines 2005). Pursuant to 10 CSR 20-6.300, permits are required for CAFOs that confine and feed or maintain more than 1,000 animal units for 45 days or more during any 12-month period.²¹ Permits may be required for facilities with fewer animal units if pollutants are discharged directly into waters of the state or other water quality issues are discovered. In Missouri, CAFOs operate under site-specific permits or one of two general permits (MOG01 or MOGS1). The MOGS1 permit does not authorize discharges for any reason. The MOG01 permit allows discharge only in the event of weather that exceeds the criteria of a catastrophic storm, and only authorizes discharge of the portion of the stormwater flow that exceeds the design storm event, which includes the direct precipitation and runoff from the 25-year, 24-hour storm event. These discharges are not expected to be significant contributors of *E. coli* to surface waters because they are rare and temporary in nature and only occur during defined catastrophic storm events that generally result in high flows that are infrequently met or exceeded.

There are 12 CAFOs located in the Missouri portion of the Spring River watershed, two Class IB and ten Class IC facilities²². Table 10 presents facility information for the existing CAFOs within the Spring River watersheds. Animal waste applied on areas under the control of a CAFO are

²¹ As defined by 10 CSR 20-6.300(1)(B)2, an animal unit is a unit of measurement to compare various animal types at an animal feeding operation. One (1) animal unit equals the following: 1.0 beef cow or feeder, cow/calf pair, veal calf, or dairy heifer; 0.5 horse; 0.7 mature dairy cow; 2.5 swine weighing over 55 pounds; 10 swine weighing less than 55 pounds; 10 sheep, lamb, or meat and dairy goats; 30 chicken laying hens or broilers with a wet handling system; 82 chicken laying hens without a wet handling system; 55 turkeys in grow-out phase; 125 chicken broilers, chicken pullets, or turkey poults in brood phase without a wet handling system.

²² An operation's "class size" is a category that is based upon the total number of animal units confined at an operation. The Class IC, IB, and IA are categories that start at 1,000, 3,000, and 7,000 animal units respectively, all of which are required by state regulation to obtain a permit. (1,000 animal units is equal to 2,500 swine; 100,000 broilers; 700 dairy cows; or 1,000 beef steers).

subject to conditions found in the permit, which include a requirement for the CAFO to develop a nutrient management plan. Section 640.760 Revised Statutes of Missouri (RSMO) establishes setback distances for surface application of liquefied animal waste from a CAFO by a third party. CAFOs violating their permit conditions as they relate to discharge or land application are potential sources of *E. coli* and may be subject to department enforcement action. When all permit requirements are met, CAFOs are not expected to be contributors of bacteria loading through direct discharge. Per Missouri Clean Water Law at 644.059 and 644.016(16) RSMo, and Missouri permit regulations at 10 CSR 20-6.300(1)(B)10, discharges of agricultural stormwater (runoff) are separate from CAFO discharges and are considered nonpoint sources. Agricultural stormwater runoff and potential pollutant contributions from unpermitted animal feeding operations are discussed in Section 5.2.1.

Table 10. Concentrated Animal Feed Operations in the Spring River watershed

Spring River (3160)				
Permit No.	Facility Name	Class Size	Treatment	Expires²³ (M/D/Y)
MOGS10232	Bawi Biak Lang	IC	Land Application	1/28/2023
MOGS10299	Carla Hurn	IC	Land Application	2/13/2028
MOGS10488	Coon Creek Sow Farm	IB	Land Application	2/13/2028
MOGS10274	Free Range Dairy-White Oak Dairy Farm	IB	Land Application	2/13/2028
MOGS10209	Free Range Dairy-Wilson Springs Dairy	IC	Land Application	2/13/2028
MOG010875	Golden City Dairy, LLC	IC	Land Application	2/25/2023
MOGS10191	James Lian Farm	IC	Land Application	2/13/2028
MOGS10238	Miriam Pum and Phun Awr Poultry Farm	IC	Land Application	2/13/2028
MOGS10259	Moe Thu Poultry Farm - A	IC	Land Application	2/13/2028
MOGS10145	Santa Fe Ranch	IC	Land Application	2/13/2028
MOGS10279	TCT Farms	IC	Land Application	2/13/2028
MOGS10527	Than Family Farm	IC	Land Application	2/13/2028
Spring River (3164)				
Permit No.	Facility Name	Class Size	Treatment	Expires (M/D/Y)
MOGS10232	Bawi Biak Lang	IC	Land Application	1/28/2023
MOGS10299	Carla Hurn	IC	Land Application	2/13/2028
MOGS10191	James Lian Farm	IC	Land Application	2/13/2028
MOGS10238	Miriam Pum and Phun Awr Poultry Farm	IC	Land Application	2/13/2028
MOGS10259	Moe Thu Poultry Farm - A	IC	Land Application	2/13/2028
Spring River (3165)				
Permit No.	Facility Name	Class Size	Treatment	Expires (M/D/Y)
MOGS10232	Bawi Biak Lang	IC	Land Application	1/28/2023
MOGS10299	Carla Hurn	IC	Land Application	2/13/2028
MOGS10191	James Lian Farm	IC	Land Application	2/13/2028
Honey Creek (3169)				

²³ Expired permits are administratively continued until the permit renewal process is completed. The permittee is obligated to adhere to all permit conditions even while the permit is expired.

Permit No.	Facility Name	Class Size	Treatment	Expires (M/D/Y)
MOGS10238	Miriam Pum and Phun Awr Poultry Farm	IC	Land Application	2/13/2028
Williams Creek (3171)				
Permit No.	Facility Name	Class	Treatment	Expires (M/D/Y)
MOGS10259	Moe Thu Poultry Farm - A	IC	Land Application	2/13/2028
Williams Creek (3172)				
Permit No.	Facility Name	Class Size	Treatment	Expires (M/D/Y)
MOGS10259	Moe Thu Poultry Farm - A	IC	Land Application	2/13/2028
White Oak Creek (3182)				
Permit No.	Facility Name	Class Size	Treatment	Expires (M/D/Y)
MOGS10274	Free Range Dairy-White Oak Dairy Farm	IB	Land Application	2/13/2028
MOGS10145	Santa Fe Ranch	IC	Land Application	2/13/2028
North Fork Spring River (3186)				
Permit No.	Facility Name	Class Size	Treatment	Expires (M/D/Y)
MOGS10488	Coon Creek Sow Farm	IB	Land Application	2/13/2028
MOGS10209	Free Range Dairy-Wilson Springs Dairy	IC	Land Application	2/13/2028
MOG010875	Golden City Dairy, LLC	IC	Land Application	2/25/2023
North Fork Spring River (3188)				
Permit No.	Facility Name	Class Size	Treatment	Expires (M/D/Y)
MOGS10488	Coon Creek Sow Farm	IB	Land Application	2/13/2028
Dry Fork (3189)				
Permit No.	Facility Name	Class Size	Treatment	Expires (M/D/Y)
MOG010875	Golden City Dairy, LLC	IC	Land Application	2/25/2023
MOGS10209	Free Range Dairy-Wilson Springs Dairy	IC	Land Application	2/13/2028

Two of the twelve permitted CAFOs within the watershed have had serious non-compliance issues over the past 15 years. While not all issues of non-compliance cause or contribute to the *E. coli* impairment, some instances including exceeding permit limit and causing pollution to waters of the state can potentially contribute to the impairment. The department's Clean Water Compliance and Enforcement section is currently overseeing active cases with the goal of returning the facilities back to compliance. MOGS10299 reported to land applying poultry litter instead of exporting off their property, a violation of their permit in May of 2025 and is considered an on-going case. MOG010875 was found to cause pollution to waters of the state in 2021 where contaminants were found and there was a failure to notify the department within 24 hours. Though not feasible to quantify the load released to waters of the state, these sources can still be considered potential loads. However, their permits will not be updated or a wasteload allocation (WLA) issued as all CAFOs currently in the watershed have permit requirements to be non-discharging facilities.

5.1.4 Municipal Separate Storm Sewer Systems

Municipal separate storm sewer systems (MS4s) are stormwater conveyance systems owned by a public entity that are not part of a sanitary sewer system, a combined sewer system, or part of a

domestic wastewater treatment facility. Federal regulations issued in 1990 require that discharges from MS4s be regulated by permits if the population of a municipality, or in some cases a county, is 100,000 or more (Phase I). As of 1999, federal regulations require permits for discharges from small MS4s that are located within a U.S. Census Bureau defined urban area or are required to hold a MS4 permit based on other criteria by the permitting authority (Phase II).

MS4 permits authorize the discharge of urban stormwater runoff. In general, urban runoff contains high levels of bacteria and may contribute to exceedances of *E. coli* criteria during and immediately after storm events in most streams throughout the county (USEPA 1983). Runoff contaminated with *E. coli* flows from open areas where soil erosion is common and from heavily paved areas (Burton & Pitt 2002). Common sources of *E. coli* contamination in urban stormwater have been documented as originating from birds, dogs, cats, and rodents (Burton & Pitt 2002). Irrigation runoff from residential lawns where pet wastes are present may also contribute *E. coli* loads to surface waters, as well as sanitary sewer overflows as discussed in Section 5.1.1. Regulated MS4s in the Spring River watershed are those maintained by the municipalities of Carl Junction and Carthage as well as the County of Jasper. Additionally, the Missouri Department of Transportation (MoDOT) holds a statewide site-specific transportation separate storm sewer system (TS4) permit (MO0137910) that applies to stormwater discharges from MoDOT right-of-ways within the urban areas.

Although stormwater discharges are often untreated, MS4 and TS4 permit holders must develop, implement, and enforce stormwater management plans to reduce the contamination of stormwater runoff and prohibit illicit discharges. Stormwater management plans must include measurable goals, annual reports, and six minimum control measures. These control measures include public education and outreach, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention. MS4 and TS4 permits may also require the development of supplemental TMDL Assumptions and Requirement Attainment Plans (ARAPs) where applicable. Missouri's list of regulated MS4s and associated stormwater management plans can be accessed at:

<https://dnr.mo.gov/water/business-industry-other-entities/permits-certification-engineering-fees/stormwater/municipal-separate-storm-sewer-systems-ms4>.

At the time of the 2020 census, the U.S. Census Bureau designates two urban areas that intersect the Missouri portion of the watershed. Currently there are three regulated MS4s that intersect the Spring River watershed (Table 11). The areas draining to any MS4 system are shown in Figure 10. Approximately 0.62 percent, or 7.33 square miles, of the 1,179.47 square miles of the Spring River watershed drains through one of three regulated MS4s. MS4s are potential contributors of *E. coli* only to the Spring River. None of the subwatersheds addressed by this TMDL contain a permitted MS4. Runoff from developed areas not having a regulated MS4 is discussed in Section 5.2.2.

Table 11. Municipal Separate Storm Sewer Systems in Spring River watershed

Spring River (3160)			
Permit No.	Facility Name	Permit Type	Expires
MOR04C052	Jasper County Phase II MS4	Phase II Municipal Separate Storm Sewer Systems Comprehensive	9/30/2026
MOR04C023	Carl Junction Phase II MS4		
MOR04C056	Carthage Phase II MS4		

5.1.5 Other Stormwater Permitted Discharges (non-MS4)

General stormwater (MOR) permits are based on the type of activity and are intended to be flexible enough to allow for ease and speed of issuance but must also protect water quality. General stormwater permits are issued for activities similar enough to be covered by a single set of requirements. Table 12 lists other stormwater discharge permits in the Spring River watershed that have not already been described in the previous subsections. Permits associated with construction or land disturbance activities (MORA) are temporary. The number of permits of this type may vary in any given year. Despite this variation, activities associated with general construction or land disturbance permits are not expected to cause or contribute to *E. coli* impairments when all permit conditions are met.

Existing and future activities for which these other general stormwater permits are issued are expected to be conducted in compliance with all permit conditions including monitoring requirements and discharge limitations. Permit conditions are intended to protect the designated uses of all water bodies within the watershed. For the facilities identified in Table 12, activities conducted in accordance with these general stormwater permit requirements are not expected to contribute *E. coli* loads in amounts substantial enough to cause or contribute to surface water impairments. Per 10 CSR 20-6.010(13)(C), if at any time the department determines that a general permit is not providing adequate water quality protection, the department may require the owner or operator of a permitted site or activity to obtain a site-specific operating permit.

Table 12. Stormwater permitted facilities in the Spring River watershed

Spring River (3160)			
Permit No.	Facility Name	Permit Type	Expires ²⁴ (M/D/Y)
MORA25495	2035 - Select Genetics Clear Ridge	Land Disturbance	2/7/2027
MORA25499	2035 - Select Genetics Hillcrest	Land Disturbance	2/7/2027
MORA25498	2035 - Select Genetics Spring River	Land Disturbance	2/8/2027
MORA21872	35 Acre Farm on 14hwy	Land Disturbance	2/7/2027
MOR130145	ADM Milling Co	Textile and Apparel/ Printing and Publishing	10/22/2028
MOR60A471	Advanced Metals LLC	Motor Vehicle Salvage	12/11/2028
MOR130173	AFB International	Textile and Apparel/ Printing and Publishing	10/22/2028
MOR80C627	Americold Logistics Site 1321	Motor Freight Transportation	11/30/2027
MOR203474	Architectural Systems Inc	Fabricating Metal, Light Industrial	8/31/2024
MOR203551	Architectural Systems Inc Shoe Factory	Fabricating Metal, Light Industrial	8/31/2024
MORA22792	Architectural Systems, Inc. Aurora	Land Disturbance	2/7/2027
MORA22709	Asbury Power Plant	Land Disturbance	2/7/2027
MORA24797	Asbury Power Plant	Land Disturbance	2/7/2027
MORA19936	Asbury Power Plant Pond Closure	Land Disturbance	2/7/2027
MORA20879	Asbury Renewable Operations Center	Land Disturbance	2/7/2027

²⁴ Expired permits are administratively continued until the permit renewal process is completed. The permittee is obligated to adhere to all permit conditions even while the permit is expired.

MOR60A110	Aurora R and R Auto Salvage Inc	Motor Vehicle Salvage	12/11/2028
MORA23967	C and H Farms LLC	Land Disturbance	2/7/2027
MORA26707	Carl Junction School Athletic Company	Land Disturbance	2/7/2027
MOR240128	Carthage Ag Service LLC	Agrichemical Facilities	4/30/2029
MORA26131	Carthage High School	Land Disturbance	2/7/2027
MOR203337	Continental Manufacturing Company	Fabricating Metal, Light Industrial	8/31/2024
MOR22A343	Cox and Son Lumber, Inc.	Lumber and Wood Primary	9/16/2024
MOR203245	Cross Machinery and Manufacturing LLC	Fabricating Metal, Light Industrial	8/31/2024
MORA21871	Darren Woody	Land Disturbance	2/7/2027
MOR240676	Earlybird Feed and Fertilizer	Agrichemical Facilities	4/30/2029
MORA26116	EDDIE SCHRADER	Land Disturbance	2/7/2027
MORA20200	Eliud Villatoro Field	Land Disturbance	2/7/2027
MOR23D117	Envision Building Products Lamar North	Plastics and Rubber Manufacturing	5/9/2027
MOR203543	Envision Building Products Lamar South	Fabricating Metal, Light Industrial	8/31/2024
MOR23D076	Envision Building Products Lamar South	Plastics and Rubber Manufacturing	5/9/2027
MORA23245	Giltner Trucking RV Park	Land Disturbance	2/7/2027
MOR203010	H.E. Williams, Inc.	Fabricating Metal, Light Industrial	8/31/2024
MORA20672	Hillhouse Pumping Company, LLC	Land Disturbance	2/7/2027
MORA22389	Hurricane Bay Car Wash	Land Disturbance	2/7/2027
MORA20852	I-44 Corridor Bridge Bundle Design Build	Land Disturbance	2/7/2027
MORA22241	Jasper	Land Disturbance	2/7/2027
MORA24078	Jasper Propane Truck Loading Facility	Land Disturbance	2/7/2027
MORA20126	Kemin Industries, Inc.	Land Disturbance	2/7/2027
MORA22247	Lawrence County 911 Center	Land Disturbance	2/7/2027
MORA21443	Lawrence County Law Enforcement Center	Land Disturbance	2/7/2027
MOR203066	Leggett and Platt - Branch 0001	Fabricating Metal, Light Industrial	8/31/2024
MOR203142	Leggett and Platt Branch 0001	Fabricating Metal, Light Industrial	8/31/2024
MOR203357	Leggett and Platt Incorporated	Fabricating Metal, Light Industrial	8/31/2024
MORA24673	Love's Travel Stop - Jasper	Land Disturbance	2/7/2027
MOR130182	Majestic Milling Company Aurora	Textile and Apparel/ Printing and Publishing	9/6/2023
MORA21936	Moore Ranch Estates	Land Disturbance	2/7/2027
MORA24920	MOUNTAIN TOP HOMES	Land Disturbance	2/7/2027
MORA24461	Noble concrete and precast	Land Disturbance	2/7/2027
MORA20385	Ozarks Trail Travel Center	Land Disturbance	2/7/2027

MOR22A354	Paltech Enterprises of Arkansas Inc	Lumber and Wood Primary	9/16/2024
MOR240208	Produce Exchange	Agrichemical Facilities	4/30/2024
MORA21367	Rainer Farms Subdivision	Land Disturbance	2/7/2027
MORA22279	Raymond Schmidt	Land Disturbance	2/7/2027
MORA24988	Recreation and Event Center	Land Disturbance	2/7/2027
MOR23D182	Redneck Outdoor Products Inc	Plastics and Rubber Manufacturing	5/9/2027
MOR203193	Reyco Granning LLC	Fabricating Metal, Light Industrial	8/31/2024
MOR60A284	Schrader's Salvage	Motor Vehicle Salvage	12/11/2028
MOR130140	Schreiber Foods, Inc. - Carthage	Textile and Apparel/ Printing and Publishing	10/22/2028
MOR130114	Schreiber Foods, Inc. - Mt Vernon	Textile and Apparel/ Printing and Publishing	10/22/2028
MORA20670	Select Genetics	Land Disturbance	2/7/2027
MORA20669	Select Genetics - Indian Ridge	Land Disturbance	2/7/2027
MOR60A454	Snethen Auto and Towing	Motor Vehicle Salvage	12/11/2023
MORA24963	Sprit of '76 Park Improvements	Land Disturbance	2/7/2027
MORA24089	TJCC Properties	Land Disturbance	2/7/2027
MOR130128	Tyson Poultry Feed Mill	Textile and Apparel/ Printing and Publishing	10/22/2028
MOR80H197	Waste Corporation of Verona	Solid Waste Transportation	8/31/2024
MOR80C272	Williams Logistics Inc	Motor Freight Transportation	11/30/2027
MORA24738	Wolf Creek-Blackberry Transmission Line	Land Disturbance	2/7/2027
Dry Hollow Creek (3163)			
Permit No.	Permit No.	Permit No.	Expires (M/D/Y)
MORA25499	2035 - Select Genetics Hillcrest	Land Disturbance	2/7/2027
Spring River (3164)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MORA25495	2035 - Select Genetics Clear Ridge	Land Disturbance	2/7/2027
MORA25498	2035 - Select Genetics Spring River	Land Disturbance	2/7/2027
MORA21872	35 Acre Farm on 14hwy	Land Disturbance	2/7/2027
MOR130173	AFB International	Textile and Apparel/ Printing and Publishing	10/22/2028
MOR203474	Architectural Systems Inc	Fabricating Metal, Light Industrial	9/9/2029
MOR203551	Architectural Systems Inc Shoe Factory	Fabricating Metal, Light Industrial	8/31/2024
MORA22792	Architectural Systems, Inc. Aurora	Land Disturbance	2/7/2027
MOR60A110	Aurora R and R Auto Salvage Inc	Motor Vehicle Salvage	12/11/2028
MORA23967	C and H Farms LLC	Land Disturbance	2/7/2027
MOR203337	Continental Manufacturing Company	Fabricating Metal, Light Industrial	8/31/2024

MORA21871	Darren Woody	Land Disturbance	2/7/2027
MOR240676	Earlybird Feed and Fertilizer	Agrichemical Facilities	4/30/2029
MORA20672	Hillhouse Pumping Company, LLC	Land Disturbance	2/7/2027
MORA20852	I-44 Corridor Bridge Bundle Design Build	Land Disturbance	2/7/2027
MORA20126	Kemin Industries, Inc.	Land Disturbance	2/7/2027
MORA22247	Lawrence County 911 Center	Land Disturbance	2/7/2027
MORA21443	Lawrence County Law Enforcement Center	Land Disturbance	2/7/2027
MOR130182	Majestic Milling Company Aurora	Textile and Apparel/ Printing and Publishing	9/6/2023
MORA21936	Moore Ranch Estates	Land Disturbance	2/7/2027
MORA24920	MOUNTAIN TOP HOMES	Land Disturbance	2/7/2027
MORA20385	Ozarks Trail Travel Center	Land Disturbance	2/7/2027
MORA24988	Recreation and Event Center	Land Disturbance	2/7/2027
MOR203193	Reyco Granning LLC	Fabricating Metal, Light Industrial	8/31/2024
MOR130114	Schreiber Foods, Inc. - Mt Vernon	Textile and Apparel/ Printing and Publishing	10/22/2028
MORA20670	Select Genetics	Land Disturbance	2/7/2027
MORA20669	Select Genetics - Indian Ridge	Land Disturbance	2/7/2027
MORA24963	Sprit of '76 Park Improvements	Land Disturbance	2/7/2027
MORA24089	TJCC Properties	Land Disturbance	2/7/2027
MOR130128	Tyson Poultry Feed Mill	Textile and Apparel/ Printing and Publishing	10/22/2028
MOR80H197	Waste Corporation of Verona	Solid Waste Transportation	8/31/2024
Spring River (3165)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOR130173	AFB International	Textile and Apparel/ Printing and Publishing	10/22/2028
MOR203474	Architectural Systems Inc	Fabricating Metal, Light Industrial	9/9/2029
MOR203551	Architectural Systems Inc Shoe Factory	Fabricating Metal, Light Industrial	8/31/2024
MOR60A110	Aurora R and R Auto Salvage Inc	Motor Vehicle Salvage	12/11/2028
MORA20672	Hillhouse Pumping Company, LLC	Land Disturbance	2/7/2027
MORA20126	Kemin Industries, Inc.	Land Disturbance	2/7/2027
MOR130182	Majestic Milling Company Aurora	Textile and Apparel/ Printing and Publishing	9/6/2023
MORA24988	Recreation and Event Center	Land Disturbance	2/7/2027
MORA24089	TJCC Properties	Land Disturbance	2/7/2027
MOR130128	Tyson Poultry Feed Mill	Textile and Apparel/ Printing and Publishing	10/22/2028
Honey Creek (3169)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MORA21872	35 Acre Farm on 14hwy	Land Disturbance	2/7/2027

MORA22792	Architectural Systems, Inc. Aurora	Land Disturbance	2/7/2027
MORA21871	Darren Woody	Land Disturbance	2/7/2027
MOR240676	Earlybird Feed and Fertilizer	Agrichemical Facilities	4/30/2029
MORA20670	Select Genetics	Land Disturbance	2/7/2027
MORA20669	Select Genetics - Indian Ridge	Land Disturbance	2/7/2027
MOR80H197	Waste Corporation of Verona	Solid Waste Transfer	8/31/2024
Honey Creek (3170)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MORA21871	Darren Woody	Land Disturbance	2/7/2027
MOR240676	Earlybird Feed and Fertilizer	Agrichemical Facilities	4/30/2029
MORA20669	Select Genetics - Indian Ridge	Land Disturbance	2/7/2027
Williams Creek (3171)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MORA23967	C and H Farms LLC	Land Disturbance	2/7/2027
MOR203337	Continental Manufacturing Company	Fabricating Metal, Light Industrial	8/31/2024
MORA20852	I-44 Corridor Bridge Bundle Design Build	Land Disturbance	2/7/2027
MORA22247	Lawrence County 911 Center	Land Disturbance	2/7/2027
MORA21443	Lawrence County Law Enforcement Center	Land Disturbance	2/7/2027
MORA21936	Moore Ranch Estates	Land Disturbance	2/7/2027
MORA24920	MOUNTAIN TOP HOMES	Land Disturbance	2/7/2027
MORA20385	Ozarks Trail Travel Center	Land Disturbance	2/7/2027
MOR203193	Reyco Granning LLC	Fabricating Metal, Light Industrial	8/31/2024
MOR130114	Schreiber Foods, Inc. - Mt Vernon	Textile and Apparel/ Printing and Publishing	10/22/2028
MORA24963	Sprit of '76 Park Improvements	Land Disturbance	2/7/2027
Williams Creek (3172)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MORA23967	C and H Farms LLC	Land Disturbance	2/7/2027
MOR203337	Continental Manufacturing Company	Fabricating Metal, Light Industrial	8/31/2024
MORA20852	I-44 Corridor Bridge Bundle Design Build	Land Disturbance	2/7/2027
MORA22247	Lawrence County 911 Center	Land Disturbance	2/7/2027
MORA21443	Lawrence County Law Enforcement Center	Land Disturbance	2/7/2027
MORA21936	Moore Ranch Estates	Land Disturbance	2/7/2027
MORA24920	MOUNTAIN TOP HOMES	Land Disturbance	2/7/2027
MORA20385	Ozarks Trail Travel Center	Land Disturbance	2/7/2027
MOR203193	Reyco Granning LLC	Fabricating Metal, Light Industrial	8/31/2024
MOR130114	Schreiber Foods, Inc. - Mt Vernon	Textile and Apparel/ Printing and Publishing	10/22/2028

MORA24963	Sprit of '76 Park Improvements	Land Disturbance	2/7/2027
Truitt Creek (3174)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOR203337	Continental Manufacturing Company	Fabricating Metal, Light Industrial	8/31/2024
MORA20852	I-44 Corridor Bridge Bundle Design Build	Land Disturbance	2/7/2027
Truitt Creek (3175)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MORA20852	I-44 Corridor Bridge Bundle Design Build	Land Disturbance	2/7/2027
North Fork Spring River (3186)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOR60A471	Advanced Metals LLC	Motor Vehicle Salvage	12/11/2028
MOR240128	Carthage Ag Service LLC	Agrichemical Facilities	4/30/2029
MOR22A343	Cox and Son Lumber, Inc.	Lumber and Wood Primary	9/16/2024
MOR203245	Cross Machinery and Manufacturing LLC	Fabricating Metal, Light Industrial	8/31/2024
MOR23D117	Envision Building Products Lamar North	Plastics and Rubber Manufacturing	5/9/2027
MOR203543	Envision Building Products Lamar South	Fabricating Metal, Light Industrial	8/31/2024
MOR23D076	Envision Building Products Lamar South	Plastics and Rubber Manufacturing	5/9/2027
MORA22241	Jasper	Land Disturbance	2/7/2027
MORA24078	Jasper Propane Truck Loading Facility	Land Disturbance	2/7/2027
MORA24673	Love's Travel Stop - Jasper	Land Disturbance	2/7/2027
MORA24461	Noble concrete and precast	Land Disturbance	2/7/2027
MOR240208	Produce Exchange	Agrichemical Facilities	4/30/2024
MOR23D182	Redneck Outdoor Products Inc	Plastics and Rubber Manufacturing	5/9/2027
North Fork Spring River (3188)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOR60A471	Advanced Metals LLC	Motor Vehicle Salvage	12/11/2028
MOR22A343	Cox and Son Lumber, Inc.	Lumber and Wood Primary	9/16/2024
MOR23D117	Envision Building Products Lamar North	Plastics and Rubber Manufacturing	5/9/2027
MOR203543	Envision Building Products Lamar South	Fabricating Metal, Light Industrial	8/31/2024
MOR23D076	Envision Building Products Lamar South	Plastics and Rubber Manufacturing	5/9/2027
MORA24078	Jasper Propane Truck Loading Facility	Land Disturbance	2/7/2027
MORA24673	Love's Travel Stop - Jasper	Land Disturbance	2/7/2027

MORA24461	Noble concrete and precast	Land Disturbance	2/7/2027
MOR240208	Produce Exchange	Agrichemical Facilities	4/30/2024
MOR23D182	Redneck Outdoor Products Inc	Plastics and Rubber Manufacturing	5/9/2027
Dry Fork (3189)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MOR240128	Carthage Ag Service LLC	Agrichemical Facilities	4/30/2029
MORA22241	Jasper	Land Disturbance	2/7/2027
Opossum Creek (3190)			
Permit No.	Facility Name	Permit Type	Expires (M/D/Y)
MORA24078	Jasper Propane Truck Loading Facility	Land Disturbance	2/7/2027

5.1.6 Illicit Straight Pipe Discharges

Illicit straight pipe discharges of domestic wastewater are also potential sources of bacteria. These types of sewage discharges bypass treatment systems, such as septic tanks or sanitary sewers, and discharge directly to a stream or an adjacent land area (Brown & Caraco 2004). Illicit straight pipe discharges are illegal and are not authorized by the federal Clean Water Act or the Missouri Clean Water Law. At present, there are no data about the presence or number of illicit straight pipe discharges in the Spring River watershed. For this reason, it is unknown if any straight pipe discharges are present in the watershed and to what significance they may contribute bacteria loads. Due to the illegal nature of these discharges, any identified illicit straight pipe discharges must be eliminated. In areas with a regulated MS4, illicit discharge detection and elimination is a required permit condition.

5.2 Nonpoint Sources

Nonpoint sources are diffuse sources with no discernible, confined, or discrete conveyance, and include all categories of discharge that do not meet the definition of a point source. Nonpoint sources are not regulated by the federal Clean Water Act and are exempt from department permit requirements by state regulation 10 CSR 20-6.010(1)(B)1. Nonpoint source pollutants are typically transported by stormwater runoff, which is minor or negligible during dry weather conditions. Although there are no specific *E. coli* data to indicate contributions from specific nonpoint sources, common nonpoint sources that have the potential to contribute bacteria loading to surface waters include agricultural lands, onsite wastewater treatment (septic) systems, and developed areas that do not have regulated storm sewer systems. Agricultural lands associated with land application of wastewater or sludge from permitted facilities, including CAFOs, are also considered nonpoint sources, so long as the activities meet agricultural practices and agronomic land application rates, without direct discharge from land application activities. Nonpoint source pollution can also result from natural background contributions, such as wildlife waste. Streams with little to no riparian buffer are most susceptible to nonpoint source pollution.

Examples of BMPs to help reduce pollutant loading from nonpoint sources is available in the department-accepted Spring River Nonpoint Source Watershed Plan. The actions described in the plan are voluntary and may be eligible for funding from the department through Section 319 grants.²⁵ Implementation of this watershed-based plan is not a requirement of this TMDL. However,

²⁵ <https://dnr.mo.gov/water/financial-assistance-opportunities/section-319-nonpoint-source-subgrants>

efforts to reduce pollutant loading from any potential nonpoint source contributor in the watershed is encouraged and will aid in meeting the water quality goals of this TMDL. More information about the watershed-based plan can be found at <https://dnr.mo.gov/document-search/spring-river-watershed-management-plan-summary-pub3065/pub3065>.

5.2.1 Agricultural Lands

Croplands, pasturelands, and lower-density animal feeding operations (AFOs) are potential sources of bacteria in surface waters. Bacteria are transported in runoff from areas fertilized with animal waste and where livestock are present. Runoff can result from precipitation or excessive irrigation. Soil and Water Conservation Districts provide funding and guidance for the development of nutrient management plans for unregulated private lands. Areas where nutrient management plans guide animal waste application and where BMPs are used to reduce soil erosion contribute less bacteria to surface waters than unmanaged areas. Although grazing areas are typically well vegetated, livestock tend to congregate near feeding and watering areas, which can create barren areas that are susceptible to erosion (Sutton 1990). Additionally, livestock that are not excluded from streams can defecate while wading and thus deposit bacteria directly into the waterway.

As noted in Section 2.4 of this document, agricultural land cover (hay and pasture, and cultivated crops) account for 79.22% of the watershed. Aside from livestock present in permitted CAFOs, the exact type and number of livestock present in the Spring River watershed is unknown. An estimate of the number of cattle in the Missouri portion of the watershed was calculated by using the available land cover data in Section 2.4 and county cattle population numbers provided in the U.S. Department of Agriculture's 2022 Census of Agriculture (NASS 2022). Using the total number of cattle in Barry, Barton, Christian, Dade, Jasper, Lawrence, and Stone counties and the proportion of each county's area of hay and pasture in the watershed to the total area of hay and pasture in each county, it is estimated that there are 153,331 cattle in the Spring River watershed (Table 13).²⁶ A study found that one gram of fresh manure from a cow on pasture contains a population of approximately 758,577 *E. coli* (Weaver et al. 2005).

Table 13. Cattle population estimates for pasture areas on the Missouri side of the Spring River watershed.

WBID	Watershed	Total Hay/Pasture in watershed (mi ²)	Cattle Population Estimate							Total Cattle in Watershed
			Lawrence	Jasper	Barton	Christian	Barry	Dade	Stone	
3160	Spring Rv.	607.55	73,554	38,998	30,665	614	2,751	6,738	10	153,331
3163	Dry Hollow Cr.	14.20	4,022							4,022
3164	Spring Rv.	158.97	41,321	0	0	614	2,751	0	10	44,696
3165	Spring Rv.	46.59	10,355	0	0	0	2,751	0	0	13,106
4112	Spring Rv. trib	2.29	648	0	0	0	0	0	10	658
3169	Honey Cr.	50.71	13,501	0	0	614	0	0	10	14,125
3170	Honey Cr.	8.66	2,345	0	0	66	0	0	10	2,421

²⁶ This analysis assumes all areas identified as hay and pasture are being used for cattle grazing and that cattle are evenly distributed among those areas. Additionally, although some animals may be confined in some areas, for purposes of this estimation the entire cattle population was assumed to be grazing on pasture areas.

WBID	Watershed	Total Hay/Pasture in watershed (mi ²)	Cattle Population Estimate							Total Cattle in Watershed
			Lawrence	Jasper	Barton	Christian	Barry	Dade	Stone	
3171	Williams Cr.	42.47	12,028	0	0	0	0	0	0	12,028
3172	Williams Cr.	42.21	11,955	0	0	0	0	0	0	11,955
3174	Truitt Cr.	24.55	6,954	0	0	0	0	0	0	6,954
3175	Truitt Cr.	21.92	6,207	0	0	0	0	0	0	6,207
3182	White Oak Cr.	41.37	8,447	2,379	0	0	0	0	0	10,826
3186	N. Fk. Spring Rv.	266.70	2,377	23,784	30,051	0	0	6,738	0	62,950
3188	N. Fk. Spring Rv.	150.94	2,063	5,771	23,293	0	0	6,738	0	37,865
3189	Dry Fk.	49.34	314	9,935	0	0	0	0	0	10,249
3190	Opossum Cr.	7.01	0	1,443	0	0	0	0	0	1,443
3199	Duval Cr.	8.23	0	1,005	832	0	0	0	0	1,837
3754	Slater Br.	1.46	0	301	0	0	0	0	0	301
			Lawrence	Jasper	Barton	Christian	Barry	Dade	Stone	
Total County Cattle			116,862	59,853	61,329	47,798	94,412	83,715	20,295	
Total County Hay/Pasture (mi²)			412.62	290.57	246.84	231.29	344.44	272.00	136.52	
Cattle. per Hay/Pasture (mi²)			283.22	205.98	248.46	206.66	274.11	307.78	148.66	

Other types of livestock such as horses and sheep may also be contributing bacteria loads in the Spring River watershed. The number and distribution of other animals in the watershed cannot be estimated from available data. Due to the large proportion of land in the watershed used for agricultural purposes, agricultural stormwater runoff is a potential contributor of *E. coli* loading to the Spring River.

5.2.2 Runoff from Developed Areas

As discussed in Section 5.1.4, there are three regulated MS4s in the Spring River watershed but many developed areas within the watershed have storm sewer systems that are not regulated by an MS4 permit. Developed areas where stormwater discharges are not regulated through MS4 permits are potential nonpoint sources of *E. coli* loading. Sources of *E. coli* loading within such developed areas are similar to those previously described for in Section 5.1.4.

As presented in Section 2.4, developed areas cover small portions of the total Spring River watershed. For the Spring River watershed, low to high intensity development comprises approximately 3.55 percent and open space comprises approximately 2.99%. Degradation of water quality associated with imperviousness has been shown to first occur in a watershed at about 10% total imperviousness and to increase in severity as imperviousness increases (Arnold & Gibbons 1996; Schueler 1994). Due to the small amount of development in the watershed, runoff from developed areas is not expected to contribute substantial amounts of *E. coli* to most of the impaired

water bodies. If the developed areas are expanded in the future, BMPs and low impact development should be considered to mitigate pollutant loading from impervious surfaces.

Four of the impaired subwatersheds of Spring River have greater than 10% combined developed land cover. They are Spring River tributary (4112) at 17.68 percent, Williams Creek (3171) at 10.93%, Williams Creek (3172) at 10.95%, and Honey Creek (3170) at 16.25%. These percentages are calculated by combining the developed high, medium, and low intensity land cover classes with developed, open space as well. The Spring River tributary (4112) watershed extends into a developed area just outside the city limits of Carthage, MO, but not into the area having a regulated MS4. The city of Mount Vernon is wholly within the Williams Creek (3171 & 3172) watersheds. For Honey Creek (3170), the city of Marionville sits at the top of the watershed. Within these watersheds, runoff from developed areas is a potential contributor of bacteria loading.

5.2.3 Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems treat and disperse domestic wastewater on the property where it is generated. When properly designed and maintained, these systems perform well and should not contribute substantial amounts of *E. coli* to surface waters. However, when these systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface water quality (Horsley & Witten 1996). The Missouri Department of Health and Senior Services (DHSS) or local administrative authorities (commonly the local health department) have jurisdiction over onsite wastewater treatment systems with a design or actual flow of 3,000 gallons per day or less. Municipalities or counties may impose more stringent or additional requirements for owners of onsite wastewater treatment systems. The Missouri Department of Health and Senior Services estimates that approximately 25% of homes in Missouri use onsite wastewater treatment systems, particularly in rural areas where public sewer systems are not available (DHSS 2018). Failing onsite wastewater treatment systems can contribute *E. coli* to nearby streams under wet or dry weather conditions directly or through surface runoff and groundwater flows. Factors that may contribute to onsite wastewater treatment system failure include age, inadequate land area, poor soil drainage, high water table, and inadequate maintenance. Proper maintenance of onsite wastewater treatment systems including septic tanks, associated drain fields, and household lagoons should minimize bacteria loading to surface waters.

The exact number of onsite wastewater treatment systems in the Spring River watershed is unknown. EPA's online input data server for the Pollutant Load Estimation Tool (PLET) provides estimates of septic system numbers by 12-digit HUC watersheds based on 1992 and 1998 data from the National Environmental Service Center (USEPA 2023).²⁷ These PLET derived estimates of septic system numbers are provided in Table 14. Based on these estimates, there are approximately 8,631 septic sewer systems in the entire watershed.

A study by the Electric Power Research Institute suggests that in parts of Missouri, up to 50% of onsite wastewater treatment systems may be failing (EPRI 2000). Due to this high failure rate, onsite wastewater treatment systems are potential sources of bacteria loading to surface waters in Missouri. However, at the time of this writing, the significance of such contributions to the *E. coli* impairments in the Spring River watershed is unknown. The greater the distance an onsite system is located from a surface water, the less likely it is to cause contamination (MU Extension 2023).

²⁷ The National Environmental Services Center is located at West Virginia University and maintains a clearinghouse for information related to, among other things, onsite wastewater treatment systems. Available URL: www.nesc.wvu.edu/

Table 14. PLET derived estimates of septic system numbers for HUC 12-digit watersheds

HUC12 Watershed Name	HUC12 Number	Mean Number of Septic Systems per HUC12	Population per Septic System
Headwaters Spring River	110702070101	1,330	2
Headwaters Honey Creek	110702070102	678	2
Honey Creek	110702070103	105	2
Hillhouse Branch-Spring River	110702070104	99	2
Williams Creek	110702070105	1,022	2
Stahl Creek	110702070106	184	2
Town of Freistatt-Spring River	110702070107	208	2
Headwaters North Fork Spring River	110702070201	59	2
Kyle Creek-North Fork Spring River	110702070202	192	2
Elm Branch-North Fork Spring River	110702070203	249	2
Pettis Creek	110702070204	33	2
West Fork Spring River	110702070205	159	2
Lamar Lake-North Fork Spring River	110702070206	751	2
Coon Creek	110702070301	81	2
Community of Boston-North Fork Spring River	110702070302	129	2
Deer Creek	110702070303	21	2
Headwaters Dry Fork	110702070304	99	2
Dry Fork	110702070305	157	2
Opossum Creek-North Fork Spring River	110702070306	213	2
Buck Branch-North Fork Spring River	110702070307	154	2
Glendale Fork	110702070308	110	2
Headwaters Little North Fork	110702070309	78	2
Little North Fork	110702070310	40	2
North Fork Spring River	110702070311	97	2
Cave Spring Branch	110702070501	131	2
Headwaters White Oak Creek	110702070502	33	2
White Oak Creek	110702070503	80	2
Dry Hollow-Spring River	110702070504	239	2
City of Carthage-Spring River	110702070505	1,503	2
Town of Alba-Spring River	110702070506	125	2
Blackberry Creek	110702070507	29	2
Town of Waco-Spring River	110702070508	243	2
Total		8,631	

5.2.4 Natural Background Contributions

Wildlife such as deer, waterfowl, raccoons, rodents, and other animals contribute to the natural background concentrations of *E. coli* that may be found in a water body. Such contributions may be a component of runoff from agricultural areas, developed areas, forest lands, and other areas. While typical wildlife populations are not expected to cause or contribute to water body impairments, animals that congregate in large groups on or near water bodies may contribute significant bacteria to surface waters. For instance, Canada geese have been found to contribute significant bacteria loads in some waters (Ishii et al. 2007). There are no watershed-specific population data for Canada geese or other waterfowl, but the Missouri Department of Conservation (MDC) conducts statewide surveys in fall and winter at participating conservation areas and wildlife refuges. Duck and geese combined counts ranged from approximately 486,860 in October 2023 to 1,154,462 in late early January 2024 (MDC 2024).

The exact number of deer in the watershed is also not known, but MDC keeps harvest records by county for each hunting season. Harvest data provides a general idea of the number of deer that may be present in an area. Table 15 presents yearly harvest for 2023-2024 white-tailed deer hunting season for the counties found in the Spring River watershed (MDC 2024). Background concentrations of bacteria may also be present in benthic sediments and, if disturbed, can be resuspended as bacteria lives longer in sediment than in water (Davis & Barr 2006; Marino & Gannon 1991). The significance of any resuspended bacteria to the impairment in Spring River watershed is unknown. Natural background contributions are included in the nonpoint source load allocation.

Table 15. 2023-2024 White-tailed deer harvest counts for Missouri counties in the Spring River watershed

County	Barry	Barton	Christian	Dade	Jasper	Lawrence	Stone
Deer Harvest counts	2,855	1,966	2,695	1,787	2,591	2,116	2,387

5.2.5 Riparian Corridor Conditions

Riparian corridor conditions have a strong influence on instream water quality. Wooded riparian buffers are a vital functional component of stream ecosystems and are instrumental in the attenuation of pollutants in runoff. Land cover within 100 feet of streams in the Spring River watershed are presented in Table 16. Agricultural areas, that is cultivated crops combined with hay and pasture, constitute approximately 53.66% of the riparian corridors of streams in the Spring River watershed. These areas may be more susceptible to *E. coli* loading due to the opportunity for direct deposition of *E. coli* from livestock without interception. Approximately 31.91% of the riparian corridors are forested, and 8.21% are wetland cover. This indicates that some *E. coli* transported from nearby cropland and pasture lands into those areas may be intercepted by forest or wetlands before it enters the streams.

Table 16. Land cover composition of riparian corridors on the Missouri side of the Spring River watershed

Land Cover Type	Square Miles	Percent
Developed, High Intensity	0.03	0.04%
Developed, Medium Intensity	0.26	0.39%
Developed, Low Intensity	0.98	1.48%

Developed, Open Space	1.43	2.15%
Barren Land	0.01	0.02%
Cultivated Crops	5.95	8.97%
Hay and Pasture	29.65	44.69%
Scrub and Herbaceous	0.49	0.74%
Forest	21.17	31.91%
Wetlands	5.45	8.21%
Open Water	0.93	1.40%
Total	66.35	100.00%



Truitt Creek (3175) at State Highway 39. MoDNR file photo. September 2024

6. Calculating Loading Capacity

A TMDL is equal to the loading capacity of a water body for a specific pollutant, which is the maximum pollutant load that a water body can assimilate and still attain and maintain water quality standards. The loading capacity is derived from the numeric water quality criterion for each pollutant or an appropriate surrogate when no numeric criterion is applicable. Once the maximum allowable pollutant load is determined, a portion is assigned to point sources as a wasteload allocation and to nonpoint sources as a load allocation. These allocations become the pollutant loading targets to restore water quality. A margin of safety (MOS) is included to account for uncertainties in scientific and technical understanding of water quality in natural systems and to ensure water quality standards are achieved after all wasteload and load allocations are met.²⁸ The loading capacity is equal to the sum of the wasteload allocation, load allocation, and the margin of safety as follows:

²⁸ CWA Section 303(d)(1)(C) and 40 CFR 130.7(c)(1) require TMDLs to incorporate a margin of safety.

$$\text{TMDL} = \text{LC} = \sum \text{WLA} + \sum \text{LA} + \text{MOS}$$

where LC is the loading capacity, $\sum \text{WLA}$ is the sum of the wasteload allocations, $\sum \text{LA}$ is the sum of the load allocations, and MOS is the margin of safety.

7. Total Maximum Daily Loads

According to 40 CFR 130.2(i), TMDLs can be expressed in terms of mass per unit time, toxicity, or other appropriate measures. The TMDLs for the Spring River watershed are expressed as *E. coli* cfu per day using a load duration curve developed using the *E. coli* criterion concentration of 126 cfu/100 mL, all possible stream flows, and a unit conversion factor.²⁹ Whole body contact A use criteria, the most stringent downstream criteria, was targeted for all impaired segments addressed by this TMDL. In some cases, this provides additional pollutant reductions beyond a given water body's applicable criterion. This provides additional certainty that water quality standards will be attained and ensures consistency with federal regulations at 40 CFR 131.10(b) and state water quality standards at 10 CSR 20-7.031(4)(E) to provide for the attainment and maintenance of water quality in downstream waters, including waters of another state. The downstream water body with whole body contact category A use criterion, therefore requiring the *E. coli* criterion concentration target of 126 cfu/100 mL, is the Spring River (3160). This criterion is less than or equal to water quality criteria for the Spring River in Kansas and Oklahoma. Establishing TMDLs using load duration curves is consistent with the Anacostia Ruling (*Friends of the Earth, Inc., et al v. EPA*, No 05-5010, April 25, 2006) and EPA guidance in response to that ruling (USEPA 2006; USEPA 2007a).

The selected TMDL target is protective of whole body contact category A, whole body contact category B, and secondary contact recreational uses. The resulting load duration curves provide a visual representation of the pollutant loading capacity of each stream at all flows. The TMDL is applicable during the recreational season when the *E. coli* criteria apply and year-round where the losing stream criteria apply. Using this approach, the available loading capacity of a stream varies with flow, but the pollutant concentration remains constant. Although TMDLs are expressed as daily mass loads, *E. coli* criteria for the protection of recreational uses are expressed as geometric mean concentrations. Therefore, fluctuations in instantaneous concentrations may occur and individual bacteria measurements greater than the applicable criterion do not necessarily indicate a violation of recreational water quality criteria. In a losing stream, however, point source discharges will be limited to 126 cfu/100 mL concentration as a maximum at all times of the year. Additional discussion about the methods used to develop the load duration curves for streams in the Spring River watershed are provided in Appendix B.

Observed *E. coli* data are plotted on the load duration curve graphs to illustrate the frequency of exceedance and the magnitude of load reductions needed to meet the TMDL. Points above the curve exceed the loading capacity and points on or below the curve are in compliance with water quality standards. The load duration curve also helps to identify and differentiate between storm-driven loading and the presence of continuous loading. Storm-driven loading is expected under wet conditions when precipitation and runoff are high. Continuous loading is evident at low flows when point source discharges have greater influence on water quality. Load reductions needed to meet the

²⁹ $\text{Load} \left(\frac{\text{count}}{\text{time}} \right) = \text{Concentration} \left(\frac{\text{count}}{\text{volume}} \right) * \text{Flow} \left(\frac{\text{volume}}{\text{time}} \right) * \text{conversion factor} (24,465,715)$

E. coli criteria can be estimated using the geometric means of observed data within each flow percentile range and are provided for each impaired stream segment in Appendix E, Tables 40E through 57E. The *E. coli* load duration curves for the *E. coli* impaired streams in the Spring River watershed are displayed in Figures 11 through 28. The y-axis quantifies the *E. coli* mass load in cfu per day at the flow conditions (percentage of time flow is equaled or exceeded) on the x-axis. Lower flows are equaled or exceeded more frequently than higher flows (i.e., greater than 90 percent of the time). The flow ranges presented are consistent with EPA guidance for using load duration curves to develop TMDLs (USEPA 2007b).

The loading capacity for each stream is calculated using 126 cfu/100 mL as the target concentration. Table 17 lists the loading capacity and allocations for the Spring River (3160) watershed. Tables 18 through 34 display specific loading capacities and allocations for all remaining subwatersheds addressed by this TMDL. Loading values presented accurately reflect calculations based on the applicable criteria concentrations, which results in bacteria loads of billions or trillions counts per day. However, due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases. Specific allocations for individual sources are discussed in Sections 8 and 9.

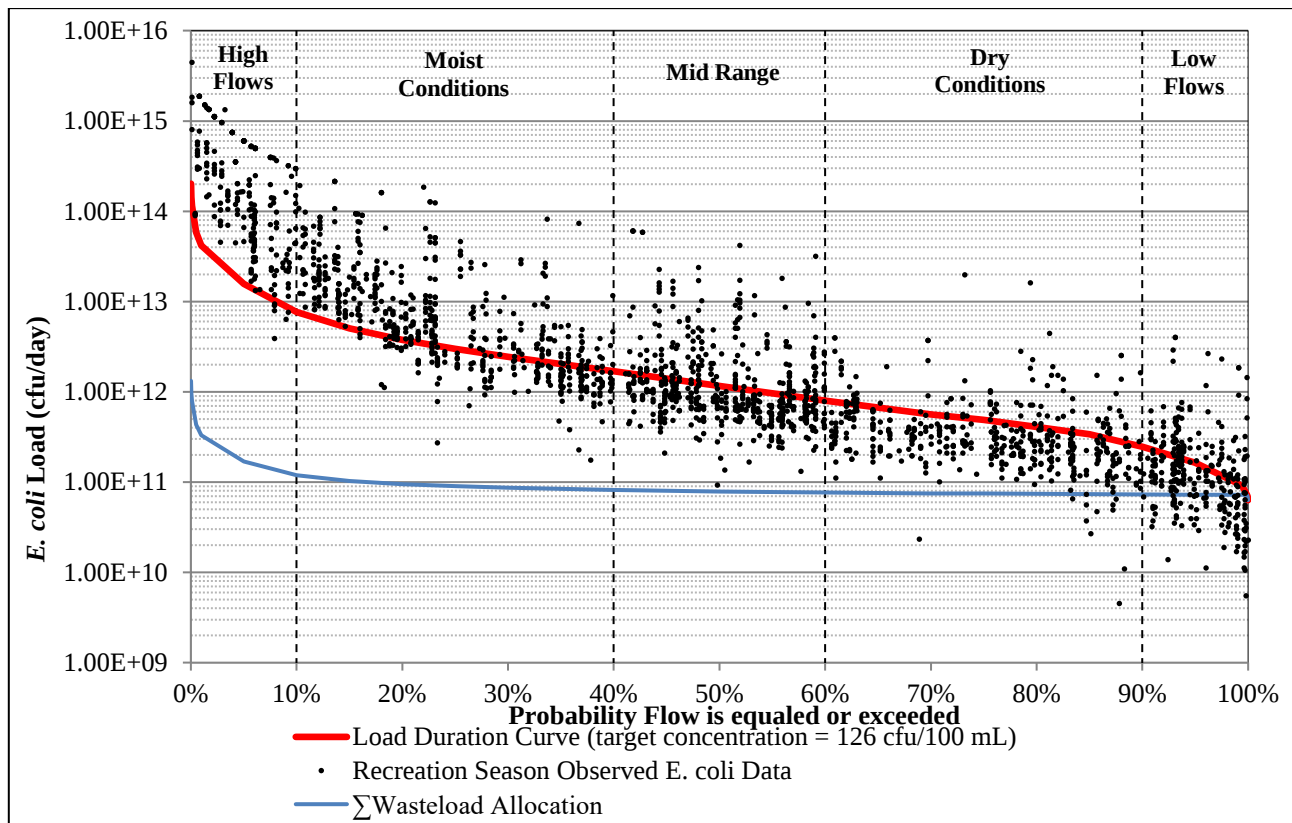


Figure 11. *E. coli* TMDL for the Spring River (3160)

Table 17. *E. coli* TMDL and allocations for the Spring River (3160) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	*MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)

95	53.30	1.64E+11	7.16E+10	1.02E+09	7.52E+10	1.64E+10
75	158.07	4.87E+11	7.16E+10	3.03E+09	3.64E+11	4.87E+10
50	375.93	1.16E+12	7.16E+10	7.20E+09	9.64E+11	1.16E+11
25	969.72	2.99E+12	7.16E+10	1.86E+10	2.60E+12	2.99E+11
5	5,084.20	1.57E+13	7.16E+10	9.74E+10	1.39E+13	1.57E+12

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

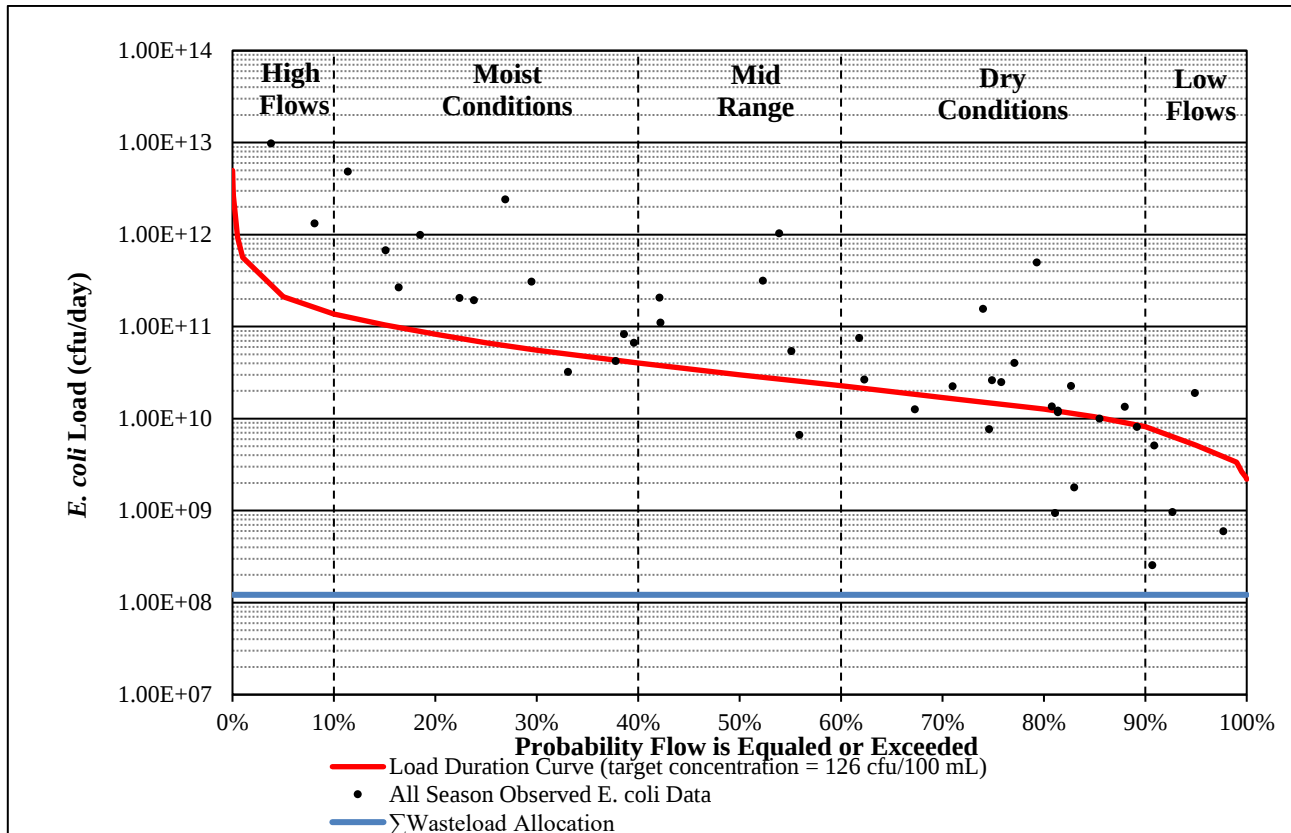


Figure 12. *E. coli* TMDL for Dry Hollow Creek (3163)

Table 18. *E. coli* TMDL and allocations for Dry Hollow Creek (3163) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	1.66	5.12E+09	1.22E+08	0.00E+00	4.49E+09	5.12E+08
75	4.76	1.47E+10	1.22E+08	0.00E+00	1.31E+10	1.47E+09
50	9.70	2.99E+10	1.22E+08	0.00E+00	2.68E+10	2.99E+09
25	21.68	6.68E+10	1.22E+08	0.00E+00	6.00E+10	6.68E+09
5	68.61	2.12E+11	1.22E+08	0.00E+00	1.90E+11	2.12E+10

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

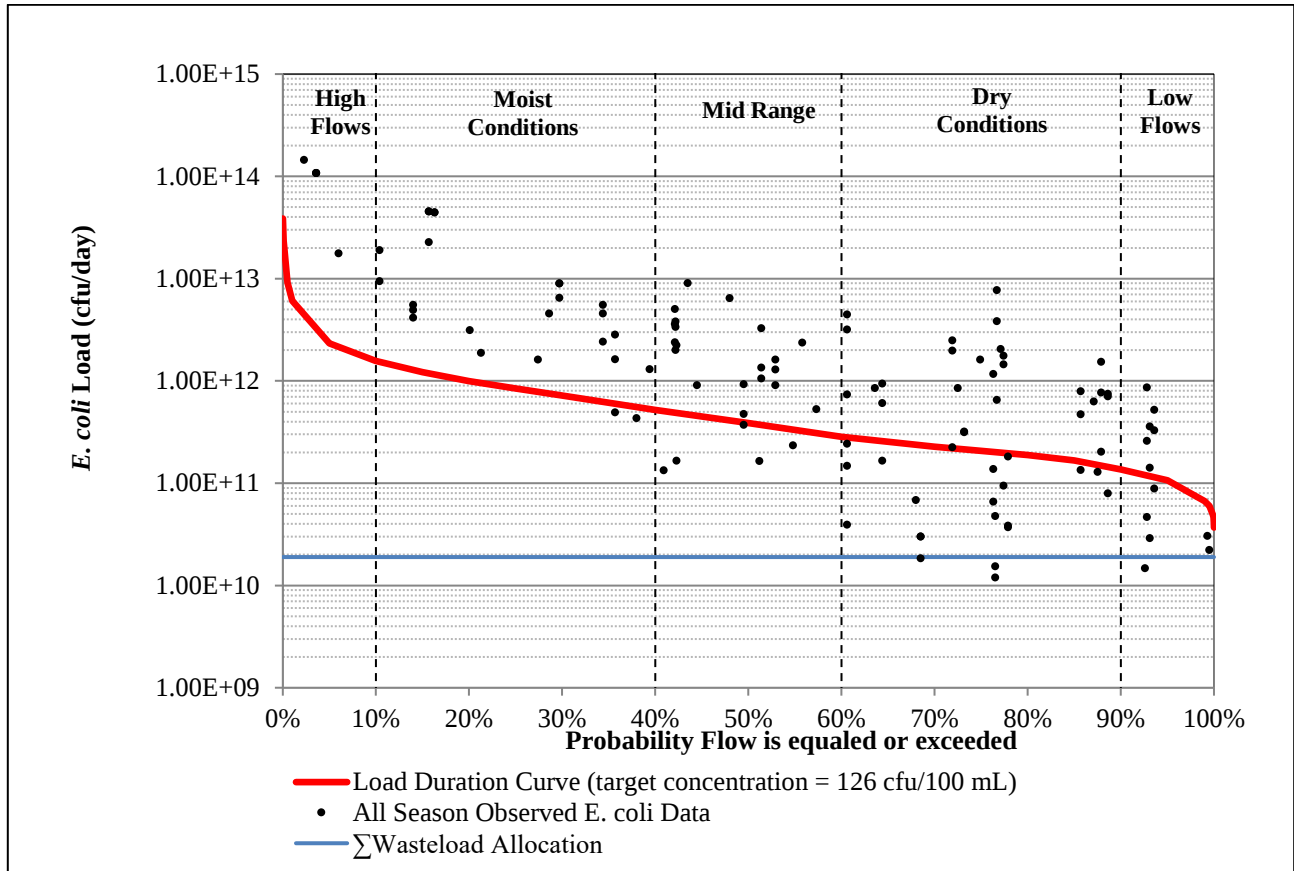


Figure 13. *E. coli* TMDL for Spring River (3164)

Table 19. *E. coli* TMDL and allocations for Spring River (3164) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	34.55	1.07E+11	1.89E+10	0.00E+00	7.69E+10	1.07E+10
75	67.14	2.07E+11	1.89E+10	0.00E+00	1.67E+11	2.07E+10
50	125.27	3.86E+11	1.89E+10	0.00E+00	3.28E+11	3.86E+10
25	273.23	8.42E+11	1.89E+10	0.00E+00	7.39E+11	8.42E+10
5	753.02	2.32E+12	1.89E+10	0.00E+00	2.07E+12	2.32E+11

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

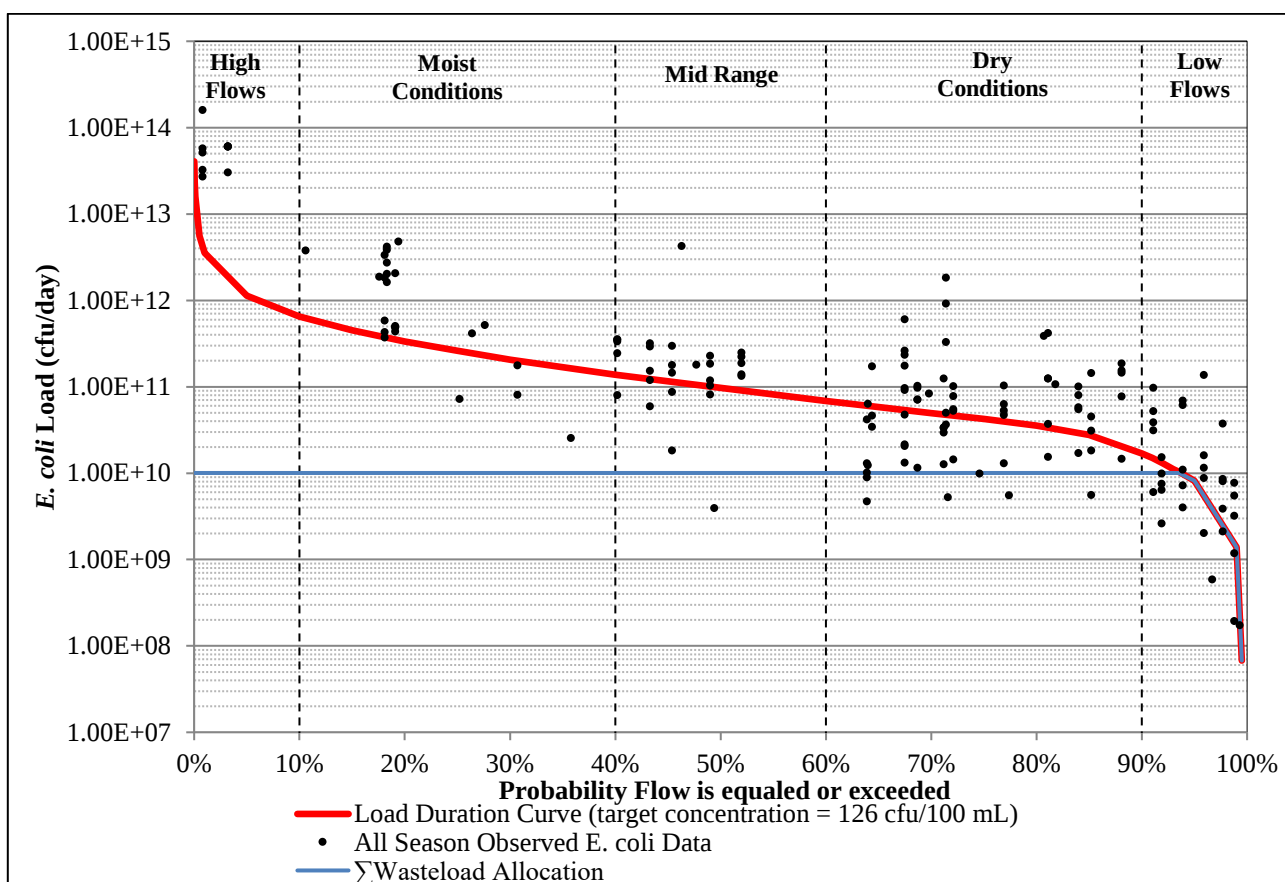


Figure 14. *E. coli* TMDL for Spring River (3165)

Table 20. *E. coli* TMDL and allocations for the Spring River (3165) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	2.65	8.16E+09	8.16E+09	0.00E+00	0.00E+00	0.00E+00
75	13.72	4.23E+10	1.00E+10	0.00E+00	2.80E+10	4.23E+09
50	31.51	9.71E+10	1.00E+10	0.00E+00	7.74E+10	9.71E+09
25	84.40	2.60E+11	1.00E+10	0.00E+00	2.24E+11	2.60E+10
5	366.41	1.13E+12	1.00E+10	0.00E+00	1.01E+12	1.13E+11

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

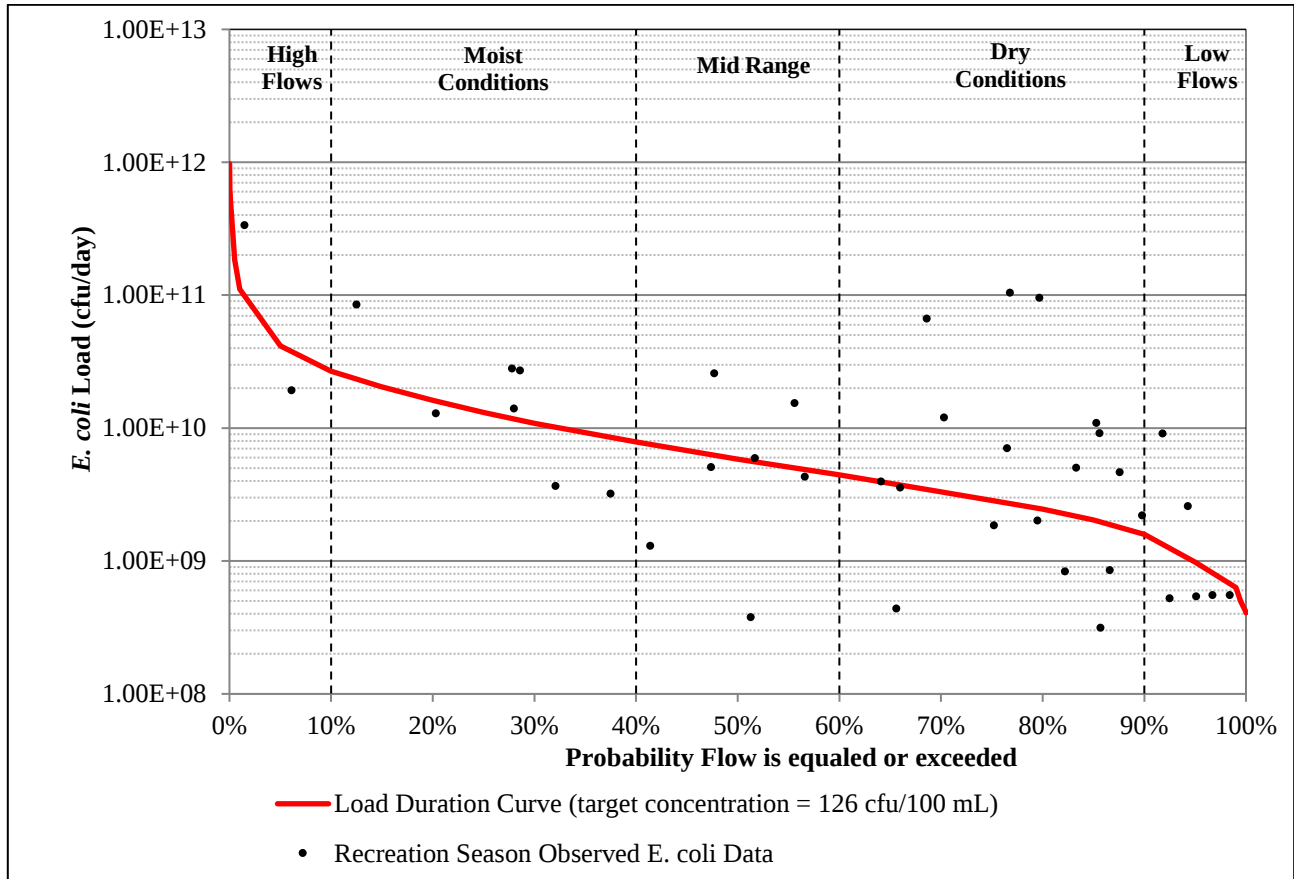
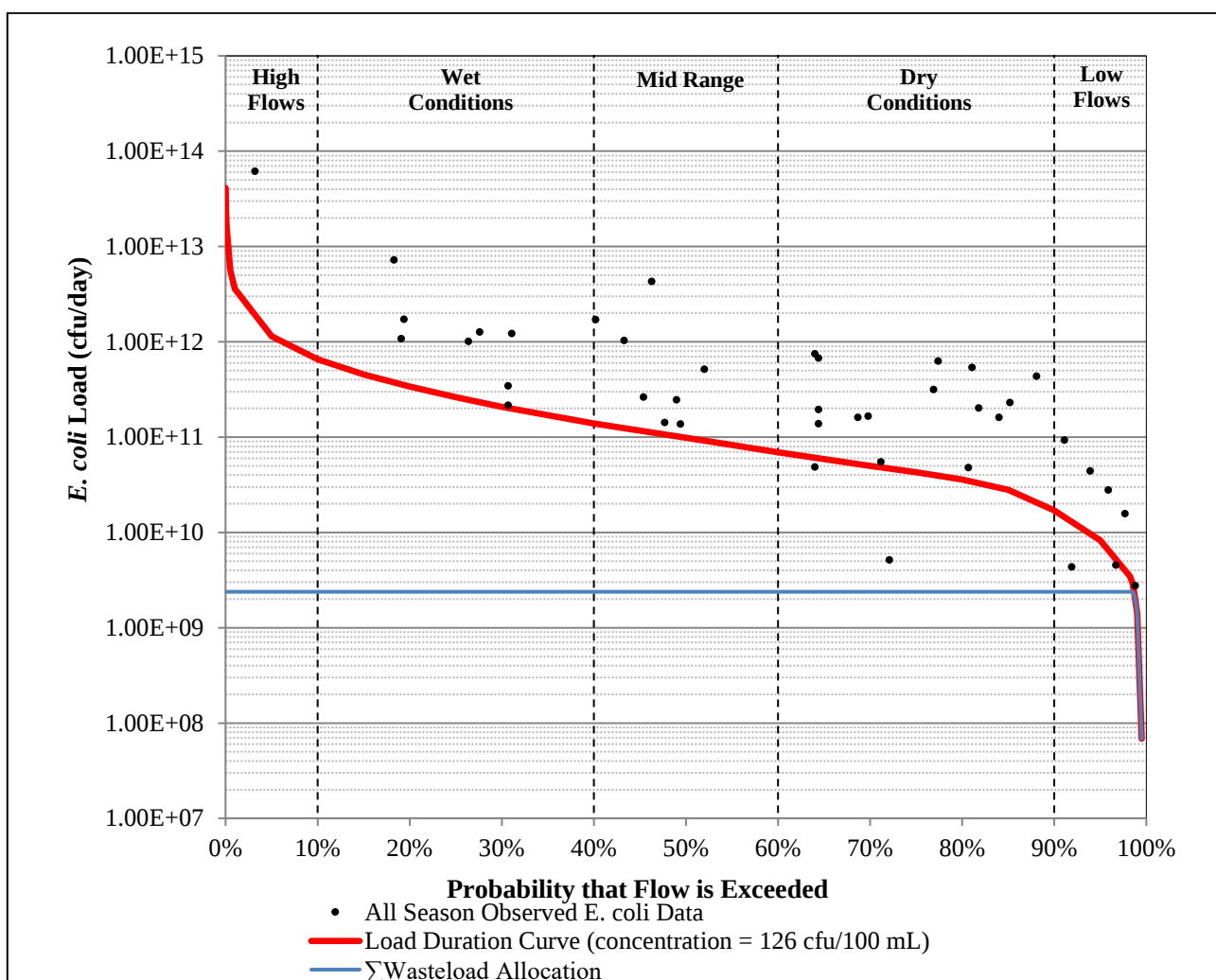


Figure 15. *E. coli* TMDL for Spring River tributary (4112)

Table 21. *E. coli* TMDL and allocations for Spring River tributary (4112) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	0.32	9.80E+08	0.00E+00	0.00E+00	8.82E+08	9.80E+07
75	0.93	2.86E+09	0.00E+00	0.00E+00	2.57E+09	2.86E+08
50	1.89	5.84E+09	0.00E+00	0.00E+00	5.25E+09	5.84E+08
25	4.24	1.31E+10	0.00E+00	0.00E+00	1.18E+10	1.31E+09
5	13.44	4.14E+10	0.00E+00	0.00E+00	3.73E+10	4.14E+09

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

Figure 16. *E. coli* TMDL for Honey Creek (3169)Table 22. *E. coli* TMDL and allocations for Honey Creek (3169) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	* Σ LA (cfu/day)	MOS (cfu/day)
95	2.68	8.26E+09	2.38E+09	0.00E+00	5.05E+09	8.26E+08
75	13.88	4.28E+10	2.38E+09	0.00E+00	3.61E+10	4.28E+09
50	31.87	9.83E+10	2.38E+09	0.00E+00	8.60E+10	9.83E+09
25	85.37	2.63E+11	2.38E+09	0.00E+00	2.34E+11	2.63E+10
5	370.63	1.14E+12	2.38E+09	0.00E+00	1.02E+12	1.14E+11

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

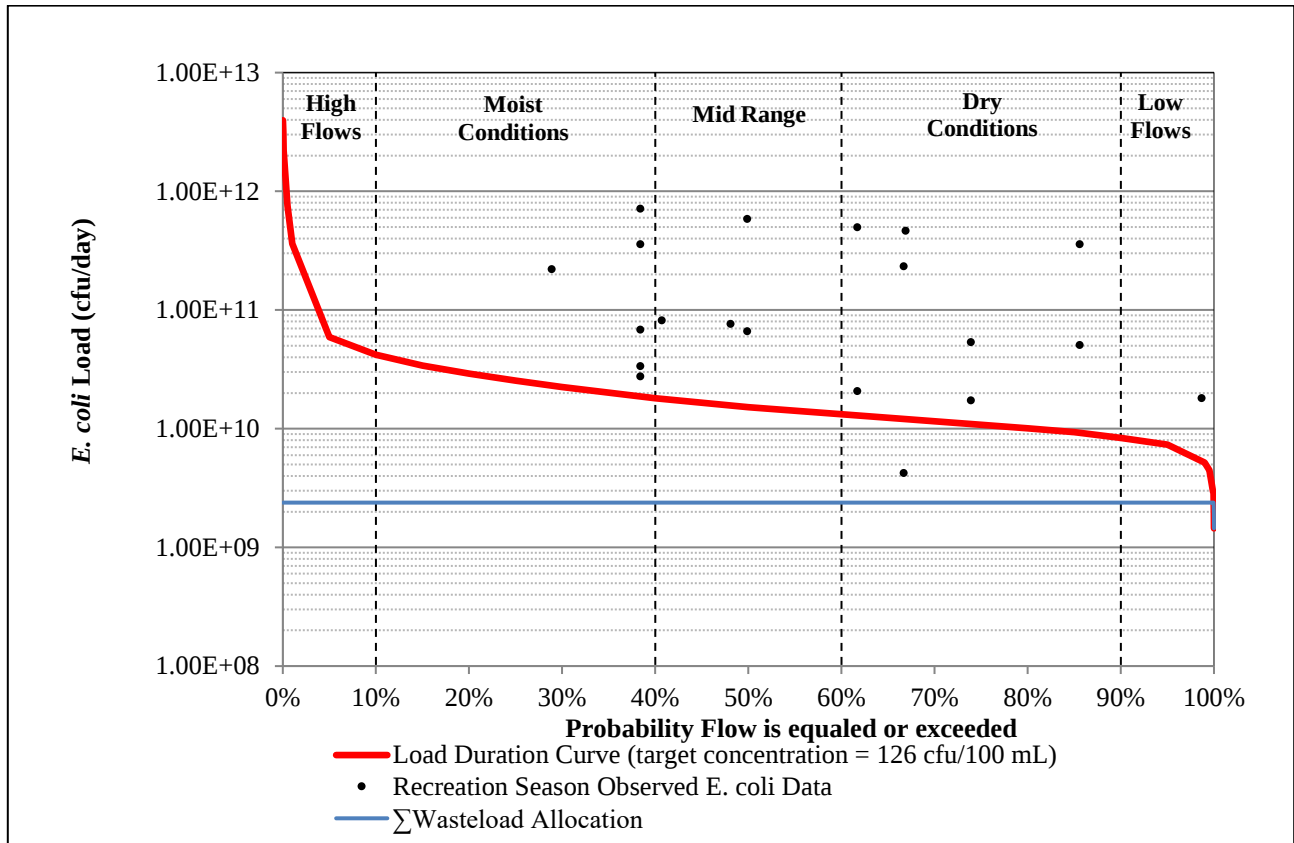


Figure 17. *E. coli* TMDL for Honey Creek (3170)

Table 23. *E. coli* TMDL and allocations for Honey Creek (3170) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	2.38	7.33E+09	2.38E+09	0.00E+00	4.21E+09	7.33E+08
75	3.50	1.08E+10	2.38E+09	0.00E+00	7.33E+09	1.08E+09
50	4.92	1.52E+10	2.38E+09	0.00E+00	1.13E+10	1.52E+09
25	8.23	2.54E+10	2.38E+09	0.00E+00	2.04E+10	2.54E+09
5	19.21	5.92E+10	2.38E+09	0.00E+00	5.09E+10	5.92E+09

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

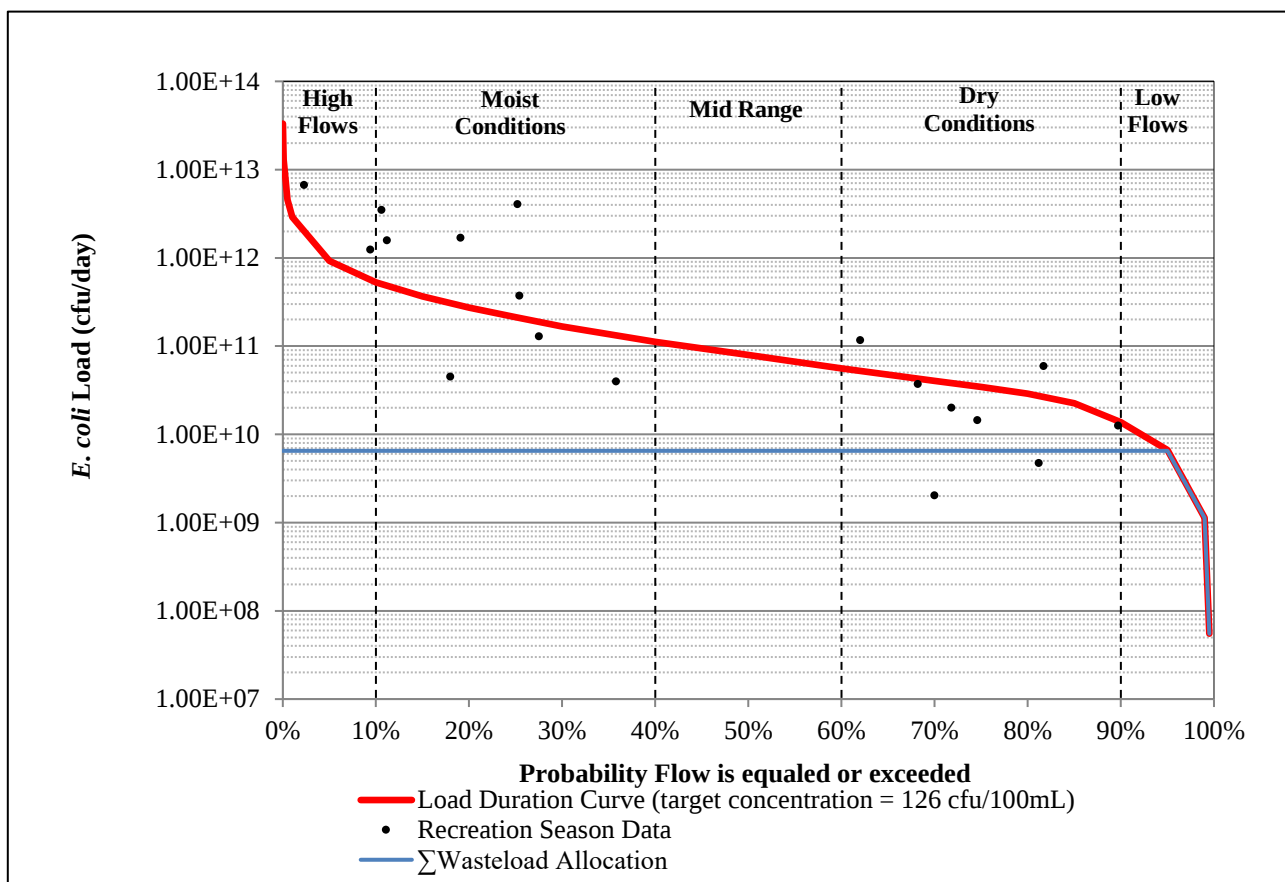


Figure 18. *E. coli* TMDL for Williams Creek (3171)

Table 24. *E. coli* TMDL and allocations for Williams Creek (3171) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	2.16	6.66E+09	6.51E+09	0.00E+00	1.49E+08	0.00E+00
75	11.19	3.45E+10	6.51E+09	0.00E+00	2.45E+10	3.45E+09
50	25.70	7.92E+10	6.51E+09	0.00E+00	6.48E+10	7.92E+09
25	68.84	2.12E+11	6.51E+09	0.00E+00	1.84E+11	2.12E+10
5	298.86	9.21E+11	6.51E+09	0.00E+00	8.22E+11	9.21E+10

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

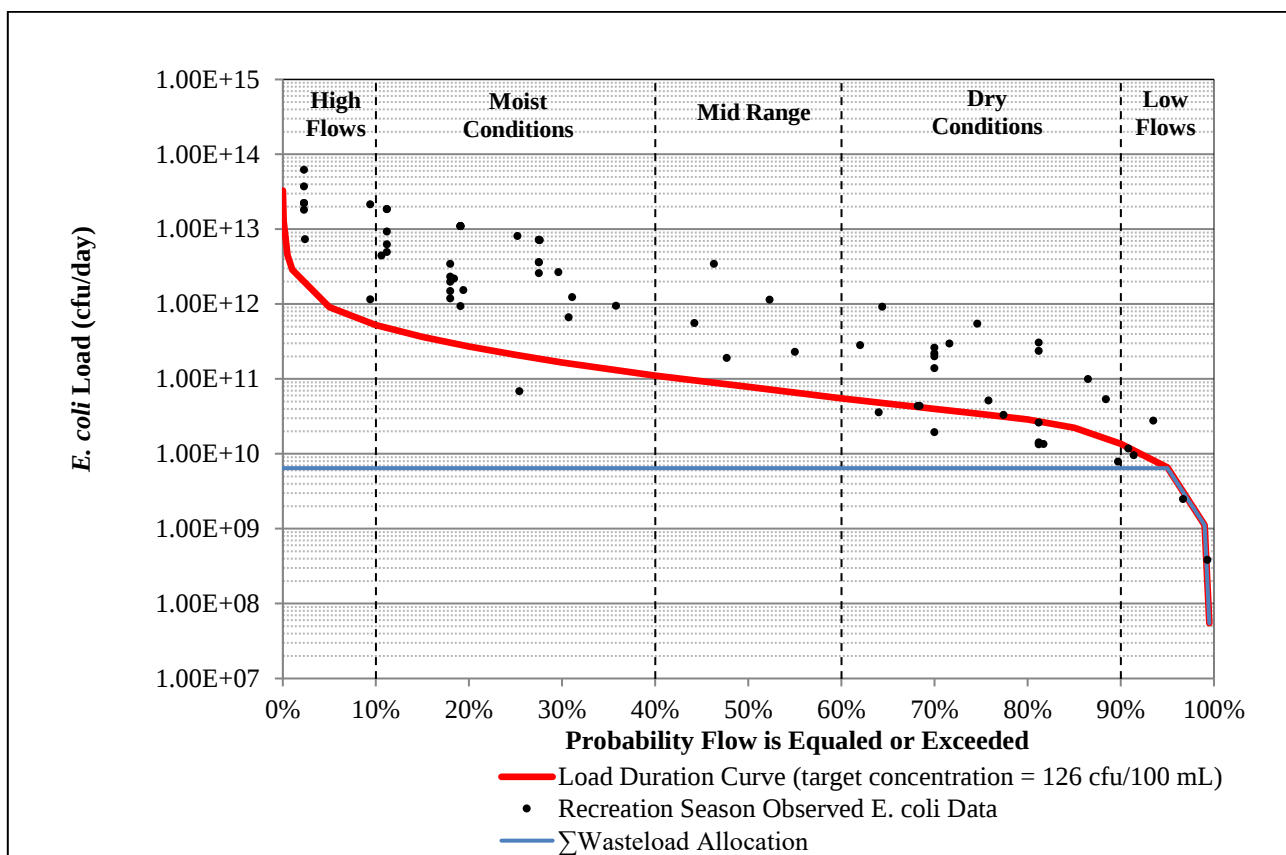
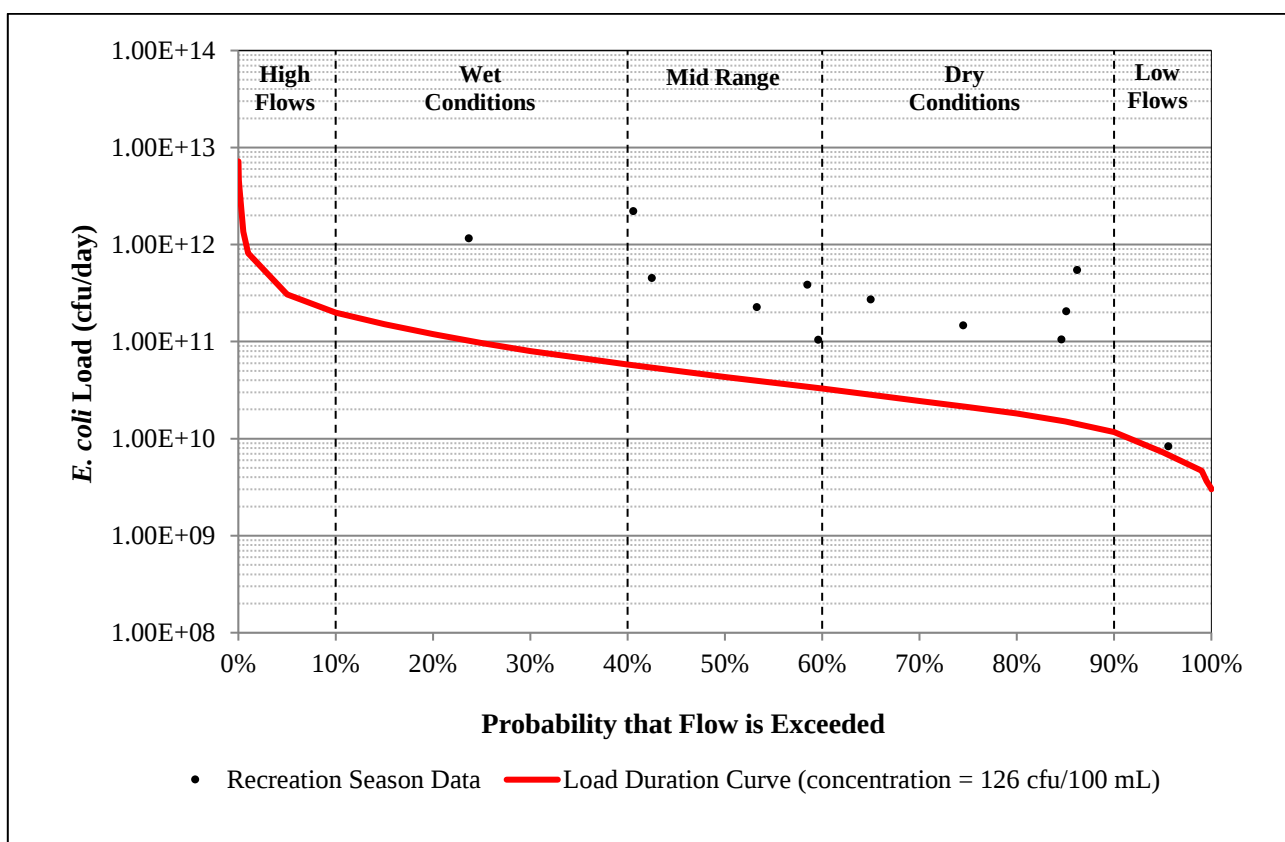


Figure 19. *E. coli* TMDL for Williams Creek (3172)

Table 25. *E. coli* TMDL and allocations for Williams Creek (3172) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	2.14	6.59E+09	6.44E+09	0.00E+00	1.54E+08	0.00E+00
75	11.08	3.42E+10	6.44E+09	0.00E+00	2.43E+10	3.42E+09
50	25.45	7.84E+10	6.44E+09	0.00E+00	6.41E+10	7.84E+09
25	68.16	2.10E+11	6.44E+09	0.00E+00	1.83E+11	2.10E+10
5	295.92	9.12E+11	6.44E+09	0.00E+00	8.14E+11	9.12E+10

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

Figure 20. *E. coli* TMDL for Truitt Creek (3174)Table 26. *E. coli* TMDL and allocations for Truitt Creek (3174) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	2.35	7.24E+09	0.00E+00	0.00E+00	6.51E+09	7.24E+08
75	6.84	2.11E+10	0.00E+00	0.00E+00	1.90E+10	2.11E+09
50	13.98	4.31E+10	0.00E+00	0.00E+00	3.88E+10	4.31E+09
25	31.32	9.66E+10	0.00E+00	0.00E+00	8.69E+10	9.66E+09
5	99.26	3.06E+11	0.00E+00	0.00E+00	2.75E+11	3.06E+10

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

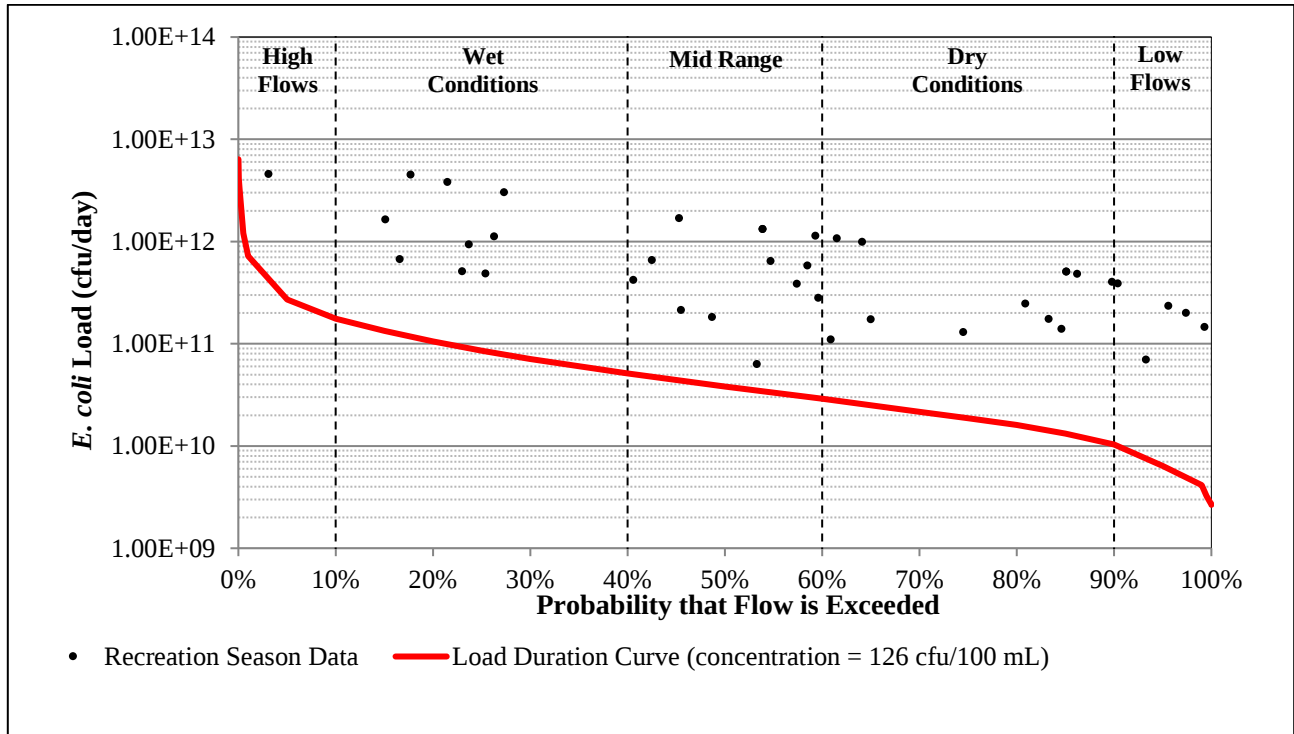


Figure 21. *E. coli* TMDL for Truitt Creek (3175)

Table 27. *E. coli* TMDL and allocations for Truitt Creek (3175) at selected flows

Percent of Time Flow is Equalled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	ΣLA (cfu/day)	MOS (cfu/day)
95	2.08	6.40E+09	0.00E+00	0.00E+00	5.76E+09	6.40E+08
75	6.05	1.87E+10	0.00E+00	0.00E+00	1.68E+10	1.87E+09
50	12.37	3.81E+10	0.00E+00	0.00E+00	3.43E+10	3.81E+09
25	27.72	8.54E+10	0.00E+00	0.00E+00	7.69E+10	8.54E+09
5	87.83	2.71E+11	0.00E+00	0.00E+00	2.44E+11	2.71E+10

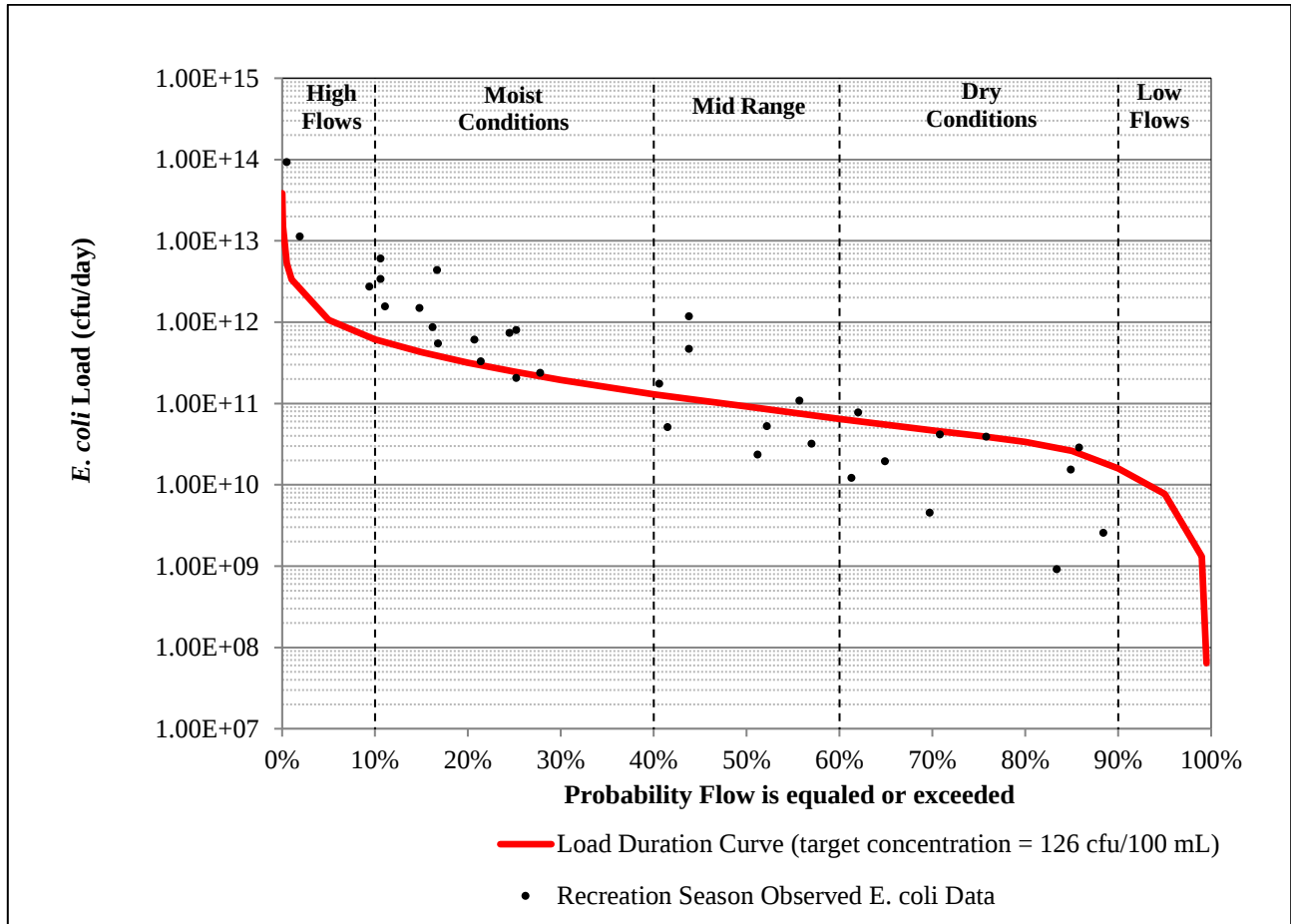


Figure 22. *E. coli* TMDL for White Oak Creek (3182)

Table 28. *E. coli* TMDL and allocations for White Oak Creek (3182) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	2.51	7.73E+09	0.00E+00	0.00E+00	6.95E+09	7.73E+08
75	12.99	4.00E+10	0.00E+00	0.00E+00	3.60E+10	4.00E+09
50	29.82	9.19E+10	0.00E+00	0.00E+00	8.27E+10	9.19E+09
25	79.86	2.46E+11	0.00E+00	0.00E+00	2.21E+11	2.46E+10
5	346.73	1.07E+12	0.00E+00	0.00E+00	9.62E+11	1.07E+11

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

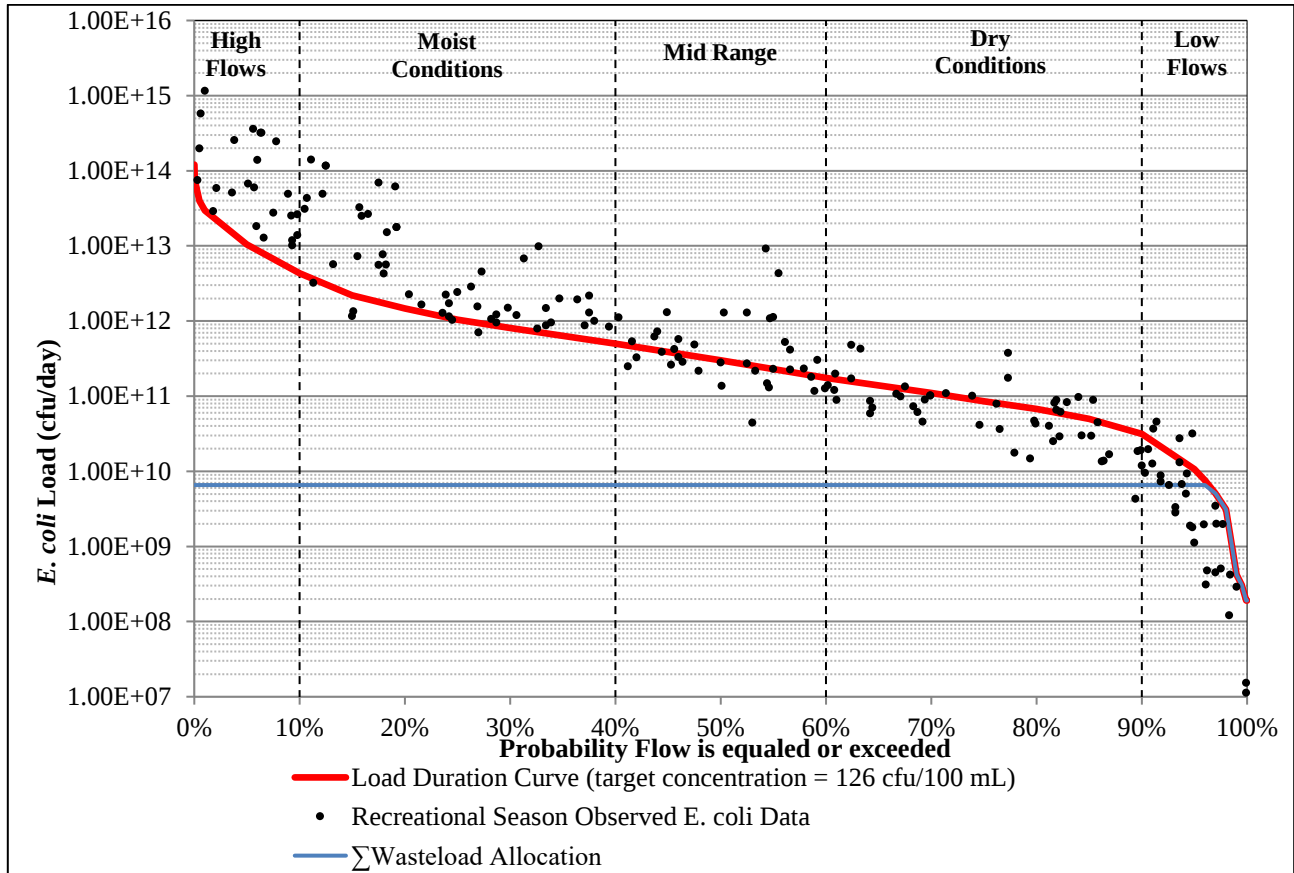


Figure 23. *E. coli* TMDL for North Fork Spring River (3186)

Table 29. *E. coli* TMDL and allocations for North Fork Spring River (3186) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	ΣLA (cfu/day)	MOS (cfu/day)
95	3.48	1.07E+10	6.56E+09	0.00E+00	3.08E+09	1.07E+09
75	27.87	8.59E+10	6.56E+09	0.00E+00	7.07E+10	8.59E+09
50	97.33	3.00E+11	6.56E+09	0.00E+00	2.63E+11	3.00E+10
25	339.75	1.05E+12	6.56E+09	0.00E+00	9.36E+11	1.05E+11
5	3,386.40	1.04E+13	6.56E+09	0.00E+00	9.39E+12	1.04E+12

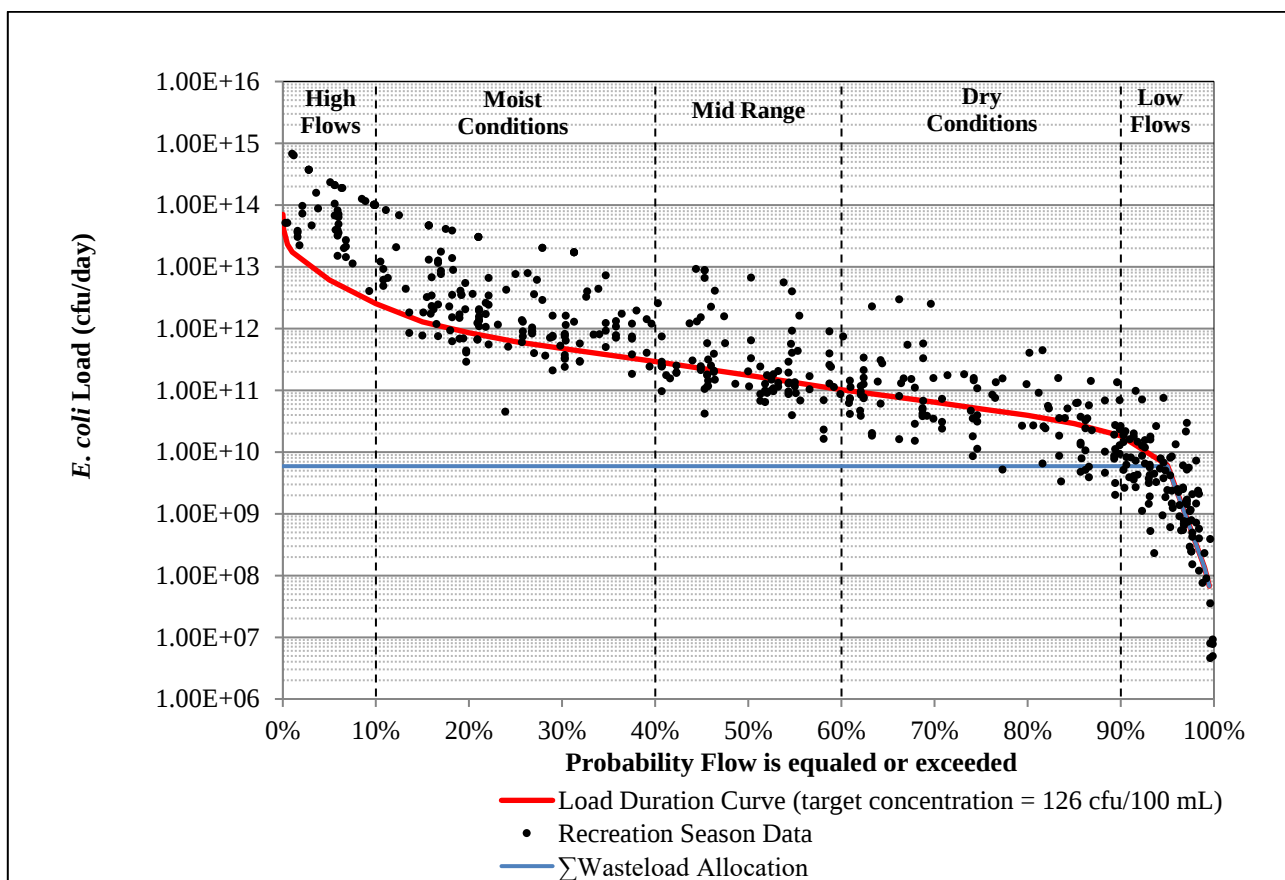


Figure 24. *E. coli* TMDL for North Fork Spring River (3188)

Table 30. *E. coli* TMDL and allocations for North Fork Spring River (3188) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	1.99	6.14E+09	5.90E+09	0.00E+00	2.44E+08	0.00E+00
75	16.23	5.00E+10	5.90E+09	0.00E+00	3.91E+10	5.00E+09
50	56.79	1.75E+11	5.90E+09	0.00E+00	1.52E+11	1.75E+10
25	198.32	6.11E+11	5.90E+09	0.00E+00	5.44E+11	6.11E+10
5	1,977.06	6.09E+12	5.90E+09	0.00E+00	5.48E+12	6.09E+11

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

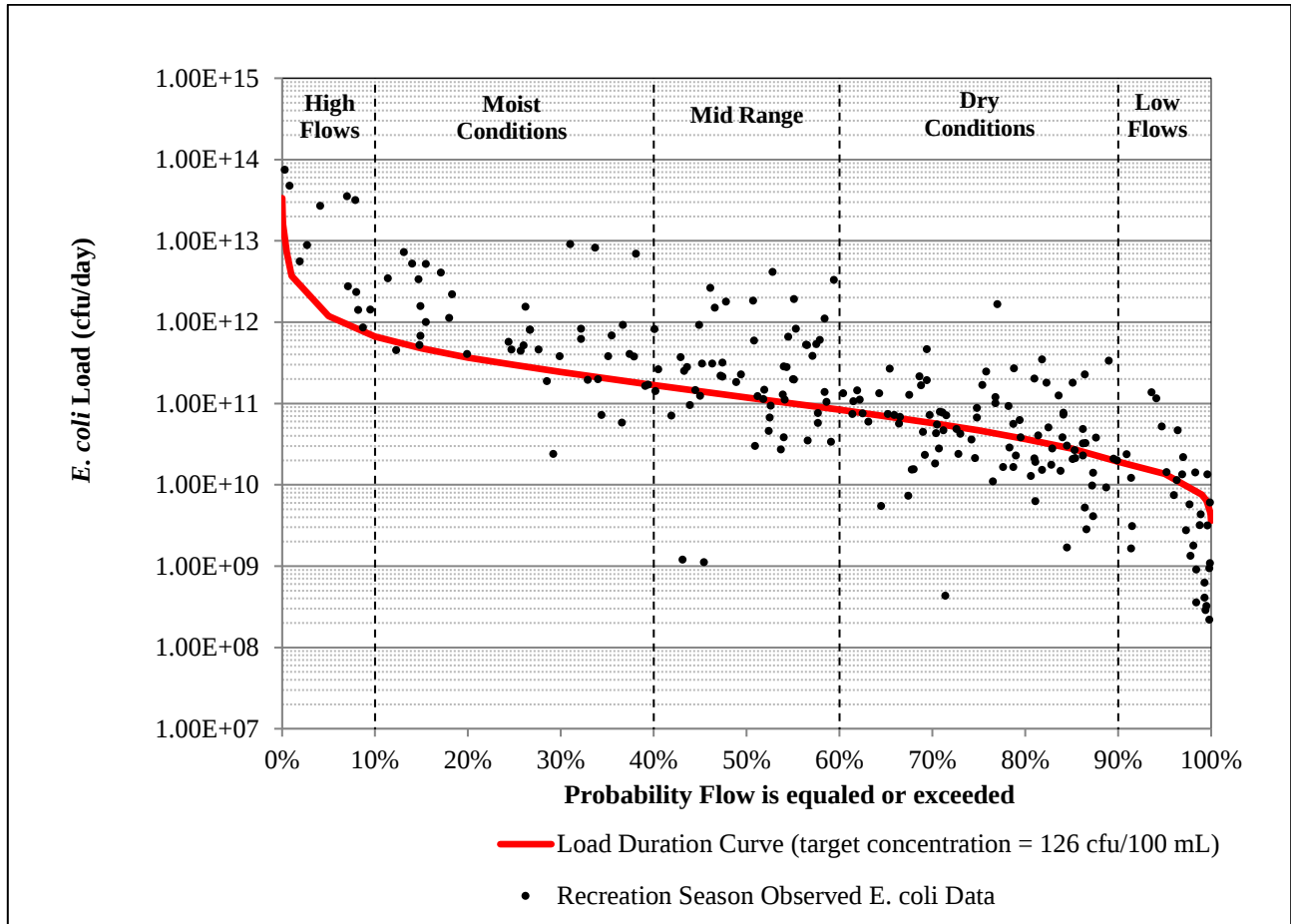


Figure 25. *E. coli* TMDL for Dry Fork (3189)

Table 31. *E. coli* TMDL and allocations for Dry Fork (3189) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	ΣLA (cfu/day)	MOS (cfu/day)
95	4.43	1.37E+10	0.00E+00	0.00E+00	1.23E+10	1.37E+09
75	15.12	4.66E+10	0.00E+00	0.00E+00	4.19E+10	4.66E+09
50	38.38	1.18E+11	0.00E+00	0.00E+00	1.06E+11	1.18E+10
25	96.28	2.97E+11	0.00E+00	0.00E+00	2.67E+11	2.97E+10
5	385.62	1.19E+12	0.00E+00	0.00E+00	1.07E+12	1.19E+11

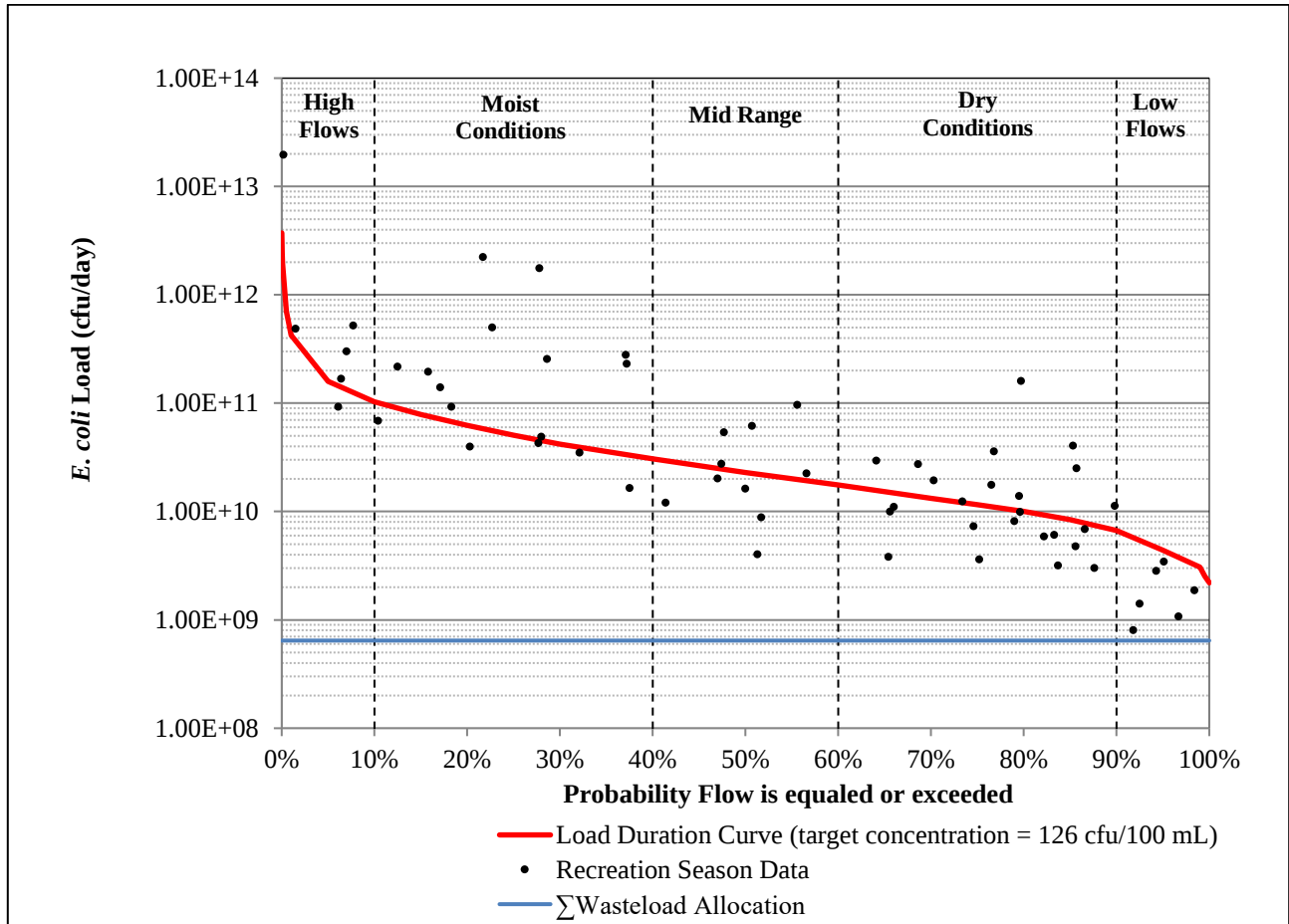


Figure 26. *E. coli* TMDL for Opossum Creek (3190)

Table 32. *E. coli* TMDL and allocations for Opossum Creek (3190) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	1.42	4.39E+09	6.44E+08	0.00E+00	3.30E+09	4.39E+08
75	3.74	1.15E+10	6.44E+08	0.00E+00	9.74E+09	1.15E+09
50	7.44	2.29E+10	6.44E+08	0.00E+00	2.00E+10	2.29E+09
25	16.40	5.06E+10	6.44E+08	0.00E+00	4.49E+10	5.06E+09
5	51.52	1.59E+11	6.44E+08	0.00E+00	1.42E+11	1.59E+10

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

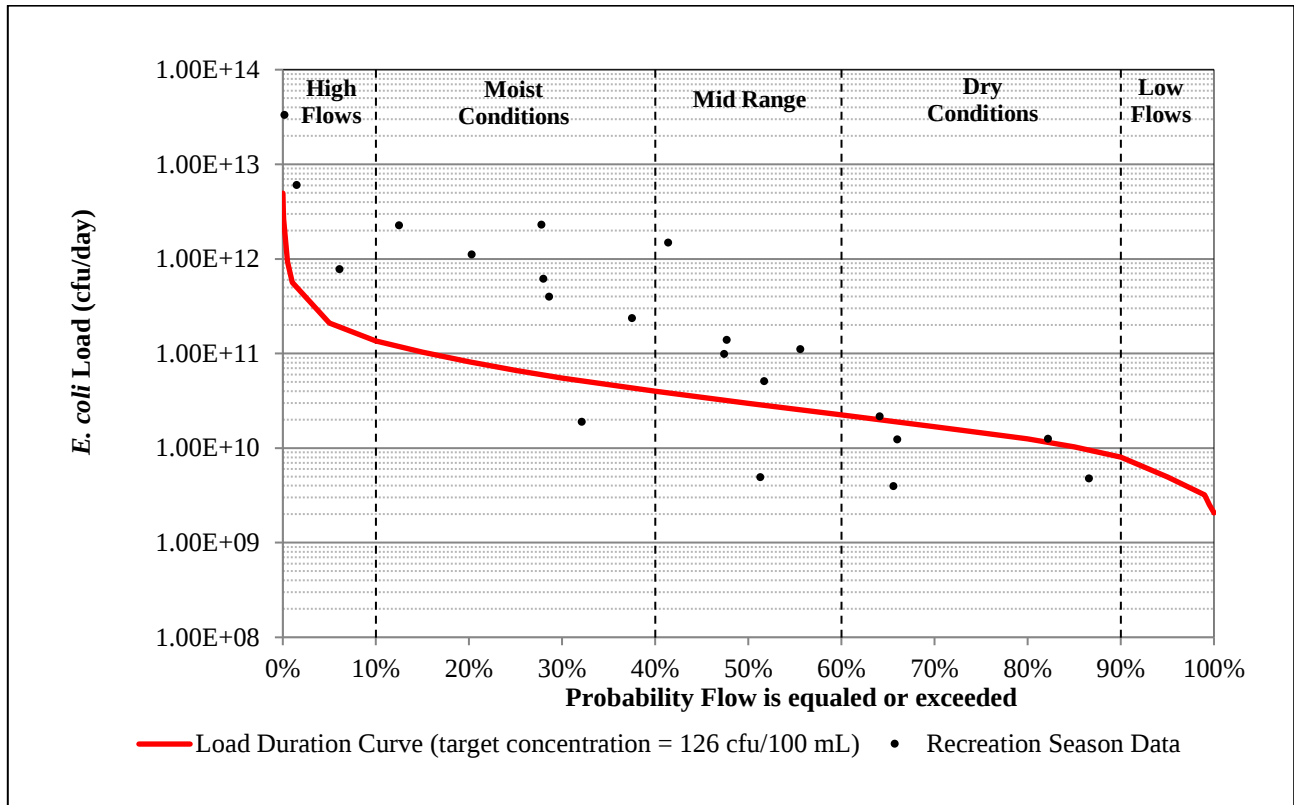


Figure 27. *E. coli* TMDL for Duval Creek (3199)

Table 33. *E. coli* TMDL and allocations for Duval Creek (3199) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	*ΣLA (cfu/day)	MOS (cfu/day)
95	1.61	4.97E+09	0.00E+00	0.00E+00	4.47E+09	4.97E+08
75	4.70	1.45E+10	0.00E+00	0.00E+00	1.30E+10	1.45E+09
50	9.61	2.96E+10	0.00E+00	0.00E+00	2.66E+10	2.96E+09
25	21.52	6.63E+10	0.00E+00	0.00E+00	5.97E+10	6.63E+09
5	68.19	2.10E+11	0.00E+00	0.00E+00	1.89E+11	2.10E+10

* Due to rounding and the limited number of decimal places displayed, summation of the allocation values displayed may not exactly match the presented load capacity in all cases.

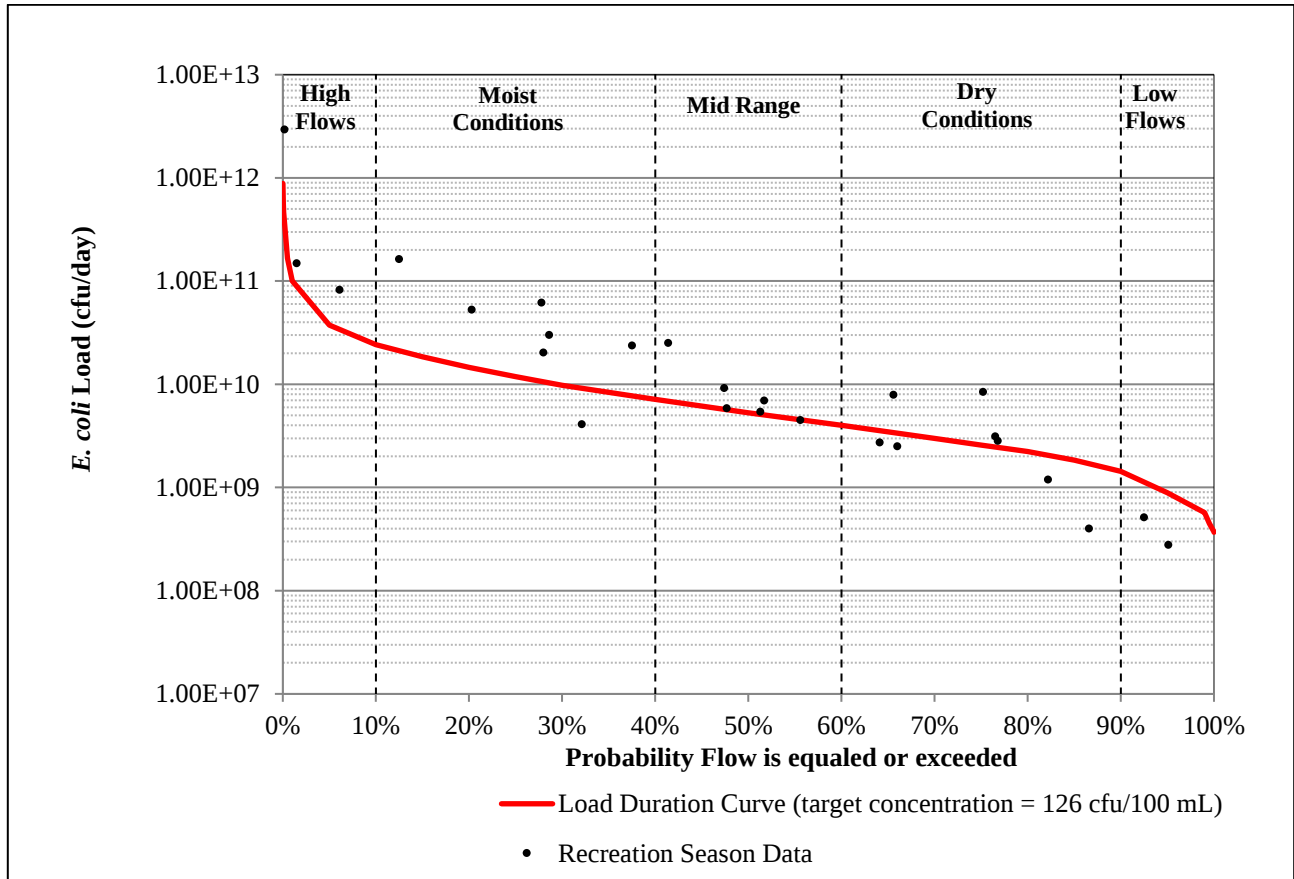


Figure 28. *E. coli* TMDL for Slater Branch (3754)

Table 34. *E. coli* TMDL and allocations for Slater Branch (3754) at selected flows

Percent of Time Flow is Equaled or Exceeded	Flow (ft ³ /s)	LC (cfu/day)	Facilities WLA (cfu/day)	MS4 WLA (cfu/day)	ΣLA (cfu/day)	MOS (cfu/day)
95	0.29	8.87E+08	0.00E+00	0.00E+00	7.98E+08	8.87E+07
75	0.84	2.58E+09	0.00E+00	0.00E+00	2.32E+09	2.58E+08
50	1.71	5.28E+09	0.00E+00	0.00E+00	4.75E+09	5.28E+08
25	3.84	1.18E+10	0.00E+00	0.00E+00	1.06E+10	1.18E+09
5	12.16	3.75E+10	0.00E+00	0.00E+00	3.37E+10	3.75E+09

The primary objective of the Clean Water Act as stated in Section 101 is “...to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” Clean Water Act Section 101(a), 33 U.S.C. Section 1251. Protection in the context of the Clean Water Act is action, like a protective TMDL, taken to maintain the integrity of the Nation’s waters.

As a result of the allocations already targeted in the restorative portion of this TMDL, the protective portion of this TMDL looks to set a protective *E. coli* target of 126 cfu/100 mL for all streams outlined in Appendix J during the recreation season (April 1 through October 31) and will be protective of whole body contact A, whole body contact B, and secondary contact recreation uses.

Though the EPA does not approve protection TMDLs, the information provided from such TMDLs will support other watershed planning efforts that drives actions to maintain attainment of water quality standards. The water bodies provided with protective status will be protected with their respective designated uses, also outlined in Appendix J, Table 93J.

8. Wasteload Allocation (Point Source Load)

The wasteload allocation is the portion of the loading capacity assigned to existing or future point sources. Pursuant to 40 CFR 122.44(d)(1)(vii)(B), effluent limits or other permit conditions must be consistent with the assumptions and requirements of TMDL wasteload allocations.

The wasteload allocations presented in this TMDL report do not preclude the establishment of future point sources. Any future point sources should be evaluated against the TMDL, the range of flows with which any additional bacterial loading will affect, and any additional requirements associated with antidegradation. Federal regulation 40 CFR 122.4(a), disallows the issuance of a NPDES permit if the conditions of the permit cannot provide for compliance with the applicable requirements of the federal Clean Water Act, or regulations promulgated under the federal Clean Water Act. Additionally, 40 CFR 122.4(i) states no permit may be issued to a new source or new discharger if the discharge from its construction or operation will cause or contribute to violation of water quality standards. After undergoing antidegradation review, any new facility that discharges wastewater containing *E. coli* should operate in a manner that will not result in loading greater than the established wasteload allocation. New facilities that generate *E. coli* but disinfect wastewater prior to discharge or implement other appropriate measures to eliminate *E. coli* from effluent during the recreational season (e.g., no discharge or batch discharge) will result in negligible bacteria loading and will be consistent with the assumptions and requirements of the established wasteload allocation. Decommissioning of onsite wastewater treatment systems and connecting to sewerage systems for wastewater treatment will result in net pollutant reductions that are consistent with the goals of this TMDL. Due to localized health concerns associated with bacteria and whole body contact recreation, water quality trading cannot be used as a mechanism for complying with the wasteload allocations established by this TMDL.

8.1 Domestic Wastewater Treatment Facilities

Allocations are based on individual facility design flows and the appropriate whole body contact category A *E. coli* criterion concentration of 126 cfu/100 mL. Actual flows that are less than the design flows may result in bacteria loads less than the calculated wasteload allocations. The wasteload allocations in this TMDL report do not authorize any facility to discharge bacteria at concentrations that exceed water quality standards but may accommodate additional facility loading due to population increases or expansions in service area. Wasteload allocations are assigned for each impaired stream where point sources are present, however the allocations are not additive. The wasteload allocations in this TMDL report are applicable at all flows during the recreational season and do not include loading that may result from sanitary sewer overflows. Sanitary sewer overflows are unpermitted discharges and not authorized under the Clean Water Act. For this reason, sanitary sewer overflows in the Spring River watershed are assigned wasteload allocations of zero at all flows.

Individual domestic facility wasteload allocations are provided in Table 35. There are four permitted facilities with domestic wastewater discharges that are receiving a wasteload allocation of zero. They are Freistatt WWTF (MO0109274), Leggett and Platt (MOG823035), Hillbilly Pumping

and Hauling Inc (MOG821008), and Jerry Marti (MOG823015). These facilities are not authorized to discharge to surface waters and, as long as the requirements of the relevant subdivisions of the permits are met, will not contribute *E. coli* to the Spring River watershed. Because these facilities are prohibited from discharging to surface waters, the wasteload allocation for these three facilities is zero at all flows. A wasteload allocation of zero is the most stringent allocation that can be assigned and indicates the need for 100 percent pollutant reduction from any contributing sources of this type. Note that not all impaired water bodies have domestic wastewater treatment facilities in their watershed. Water bodies without domestic facilities, and therefore not listed in Table 35, are Truitt Creek (3174 & 3175), White Oak Creek (3182), Dry Fork (3189), Duval Creek (3199), and Slater Branch (3754).

Table 35. Wasteload allocations for permitted domestic wastewater discharges in the Spring River watershed

Spring River (3160)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MO0089036	Alba WWTP	126	4.77E+08
MO0114740	Asbury WWTF	126	8.51E+07
MO0036757	Aurora WWTP	126	9.54E+09
MOGDS0076	Baptist Hill Camp WWTF	126	7.15E+07
MO0034410	Blue Top Motel and Cafe	126	4.53E+07
MO0039136	Carthage WWTP	126	3.34E+10
MO0109274	Freistatt WWTF	0*	0.00E+00
MO0031658	Golden City WWTF	126	1.48E+09
MOG821008	Hillbilly Pumping and Hauling Inc	0*	0.00E+00
MO0044202	Jasper WWTF	126	6.44E+08
MOG823015	Jerry Marti	0*	0.00E+00
MO0044172	Lamar WWTF	126	3.67E+09
MOG823035	Leggett and Platt	0*	0.00E+00
MO0096270	Living Word Estates WWTP	126	2.58E+07
MO0023159	Marionville WWTP	126	2.38E+09
MO0129755	MAWC Purcell WWTF	126	2.07E+08
MO0041149	Miller WWTF	126	3.58E+08
MO0116581	Mindenmines WWTF	126	1.91E+08
MO0022381	Mount Vernon WWTP	126	6.44E+09
MO0115321	Stotts City WWTP	126	1.22E+08
MO0124541	Sunset MHP WWTF	126	3.33E+07
MO0120456	Super 8 Lamar WWTP	126	2.92E+07
MO0092525	Verona WWTP	126	5.08E+08
Total			5.97E+10
Dry Hollow Creek (3163)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)

MO0115321	Stotts City WWTP	126	1.22E+08
Spring River (3164)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MO0036757	Aurora WWTP	126	9.54E+09
MOGDS0076	Baptist Hill Camp WWTF	126	7.15E+07
MO0109274	Freistatt WWTF	0*	0.00E+00
MO0023159	Marionville WWTP	126	2.38E+09
MO0022381	Mount Vernon WWTP	126	6.44E+09
MO0092525	Verona WWTP	126	5.08E+08
Total			1.89E+10
Spring River (3165)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MO0036757	Aurora WWTP	126	9.54E+09
MO0092525	Verona WWTP	126	5.08E+08
Total			1.00E+10
Spring River trib. (4112)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MOG823035	Leggett and Platt	0*	0.00E+00
Honey Creek (3169)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MO0023159	Marionville WWTP	126	2.38E+09
Honey Creek (3170)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MO0023159	Marionville WWTP	126	2.38E+09
Williams Creek (3171)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MOGDS0076	Baptist Hill Camp WWTF	126	7.15E+07
MO0022381	Mount Vernon WWTP	126	6.44E+09
Total			6.51E+09
Williams Creek (3172)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MO0022381	Mount Vernon WWTP	126	6.44E+09
North Fork Spring River (3186)			
Permit No.	Facility Name		WLA (cfu/day)

		<i>E. coli</i> Target Concentration (cfu/100 mL)	
MO0089036	Alba WWTP	126	4.77E+08
MO0034410	Blue Top Motel and Cafe	126	4.53E+07
MO0031658	Golden City WWTF	126	1.48E+09
MOG821008	Hillbilly Pumping and Hauling Inc	0*	0.00E+00
MO0044202	Jasper WWTF	126	6.44E+08
MOG823015	Jerry Marti	0*	0.00E+00
MO0044172	Lamar WWTF	126	3.67E+09
MO0096270	Living Word Estates WWTP	126	2.58E+07
MO0116581	Mindenmines WWTF	126	1.91E+08
MO0120456	Super 8 Lamar WWTP	126	2.92E+07
Total			6.56E+09
North Fork Spring River (3188)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MO0034410	Blue Top Motel and Cafe	126	4.53E+07
MO0031658	Golden City WWTF	126	1.48E+09
MO0044202	Jasper WWTF	126	6.44E+08
MOG823015	Jerry Marti	0*	0.00E+00
MO0044172	Lamar WWTF	126	3.67E+09
MO0096270	Living Word Estates WWTP	126	2.58E+07
MO0120456	Super 8 Lamar WWTP	126	2.92E+07
Total			5.89E+09
Opossum Creek (3190)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/day)
MO0044202	Jasper WWTF	126	6.44E+08

* These facilities are not authorized to discharge to surface waters and, as long as the requirements of the relevant subdivisions of the permits are met, will not contribute *E. coli* to the Spring River watershed. Because these facilities are prohibited from discharging to surface waters, the wasteload allocation for these three facilities is zero at all flows.

8.2 Industrial Facilities

There is one permitted industrial facility located in the Spring River watershed that will receive a wasteload allocation. The Butterball LLC (MO0082767) facility contributes flow and potential loading to just the Spring River (3160) impaired stream segment. There are three other facilities that could be a source of *E. coli*, Triple E Processing (MOG220031), Dean Troyer (MOG220124), and Hillbilly Pumping and Hauling Inc (MOG822182). They are all no discharge facilities or land apply and therefore each receive a WLA of zero at all flows. All remaining industrial facilities do not actively generate *E. coli* and are not expected to cause or contribute to the *E. coli* impairment of Spring River or its tributaries. For this reason, the wasteload allocation for these facilities is set to zero at all flows. Each permitted industrial facility is listed below, in Table 36, with their target concentration and WLA. Note that not all impaired water bodies have industrial permitted facilities

in their watershed. Those without, and therefore not listed in Table 36 are Dry Hollow Creek (3163), Honey Creek (3170), White Oak Creek (3182), Duval Creek (3199), and Slater Branch (3754).

Table 36. Wasteload allocations for industrial permitted facilities in the Spring River watershed

Spring River (3160)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MOG251003	Allergon	0	0.00E+00
MO0095362	Asbury Renewable Operations Center	0	0.00E+00
MO0002356	BCP Ingredients, Inc.	0	0.00E+00
MOG490765	Blevins Asphalt Construction Co Inc	0	0.00E+00
MO0082767	Butterball, LLC	126	1.19E+10
MOG490244	Carthage Crushed Limestone	0	0.00E+00
MOG490349	Coastal Emulsions of Missouri	0	0.00E+00
MOG220124	Dean Troyer	0	0.00E+00
MO0116874	Empire - Energy Center - Sarcoxie	0	0.00E+00
MOG750049	Exit 33 LLC	0	0.00E+00
MOG350350	Fuel Marketing Corp Jasper Facility	0	0.00E+00
MOG490944	G and H Redi-Mix Lamar	0	0.00E+00
MOG822182	Hillbilly Pumping and Hauling Inc	0	0.00E+00
MOG491162	Iowa Limestone Company	0	0.00E+00
MO0112500	IsoNova Technologies LLC	0	0.00E+00
MOG491139	Jasper Quarry	0	0.00E+00
MOG490063	Jasper Quarry	0	0.00E+00
MOG490620	Kay Concrete Materials Co Mount Vernon	0	0.00E+00
MOG490619	Kay Concrete Materials Company Aurora	0	0.00E+00
MO0136760	Kemin Industries, Inc.	0	0.00E+00
MO0110272	Lamar Closed Sanitary Landfill	0	0.00E+00
MOG640014	Lamar Municipal DWTP	0	0.00E+00
MO0138592	Lamarti's Truck Stop	0	0.00E+00
MOG350157	MFA Oil Bulk Plant Aurora	0	0.00E+00
MOG350161	MFA Oil Bulk Plant Golden City	0	0.00E+00
MOG350160	MFA Oil Bulk Plant Jasper	0	0.00E+00
MO0139947	Missouri and Northern Arkansas Railroad	0	0.00E+00
MOG940249	Petro Card 24	0	0.00E+00
MO0106861	Phillips 66 Mount Vernon Terminal	0	0.00E+00
MOG140075	Travel Centers of America	0	0.00E+00
MOG220031	Triple E Processing	0	0.00E+00
Total			1.19E+10
Spring River (3164)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MO0002356	BCP Ingredients, Inc.	0	0.00E+00
MO0112500	IsoNova Technologies LLC	0	0.00E+00
MOG490620	Kay Concrete Materials Co Mount Vernon	0	0.00E+00
MOG490619	Kay Concrete Materials Company Aurora	0	0.00E+00
MO0136760	Kemin Industries, Inc.	0	0.00E+00
MOG350157	MFA Oil Bulk Plant Aurora	0	0.00E+00
MOG940249	Petro Card 24	0	0.00E+00
MOG140075	Travel Centers of America	0	0.00E+00

MOG220031	Triple E Processing	0	0.00E+00
MO0106861	Phillips 66 Mount Vernon Terminal	0	0.00E+00
Spring River (3165)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MO0002356	BCP Ingredients, Inc.	0	0.00E+00
MO0112500	IsoNova Technologies LLC	0	0.00E+00
MOG490619	Kay Concrete Materials Company Aurora	0	0.00E+00
MO0136760	Kemin Industries, Inc.	0	0.00E+00
MOG220031	Triple E Processing	0	0.00E+00
Spring River trib. (4112)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MOG251003	Allergon	0	0.00E+00
Honey Creek (3169)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MOG350157	MFA Oil Bulk Plant Aurora	0	0.00E+00
MOG940249	Petro Card 24	0	0.00E+00
Williams Creek (3171)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MOG490620	Kay Concrete Materials Co Mount Vernon	0	0.00E+00
MO0106861	Phillips 66 Mount Vernon Terminal	0	0.00E+00
MOG140075	Travel Centers of America	0	0.00E+00
Williams Creek (3172)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MOG490620	Kay Concrete Materials Co Mount Vernon	0	0.00E+00
MO0106861	Phillips 66 Mount Vernon Terminal	0	0.00E+00
MOG140075	Travel Centers of America	0	0.00E+00
Truitt Creek (3174)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MO0106861	Phillips 66 Mount Vernon Terminal	0	0.00E+00
Truitt Creek (3175)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MO0106861	Phillips 66 Mount Vernon Terminal	0	0.00E+00
North Fork Spring River (3186)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MOG350350	Fuel Marketing Corp Jasper Facility	0	0.00E+00
MOG490944	G and H Redi-Mix Lamar	0	0.00E+00
MOG491162	Iowa Limestone Company	0	0.00E+00
MOG491139	Jasper Quarry	0	0.00E+00
MOG490063	Jasper Quarry	0	0.00E+00

MO0110272	Lamar Closed Sanitary Landfill	0	0.00E+00
MOG640014	Lamar Municipal DWTP	0	0.00E+00
MO0138592	Lamarti's Truck Stop	0	0.00E+00
MOG350161	MFA Oil Bulk Plant Golden City	0	0.00E+00
MOG350160	MFA Oil Bulk Plant Jasper	0	0.00E+00
North Fork Spring River (3188)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MOG490944	G and H Redi-Mix Lamar	0	0.00E+00
MOG491162	Iowa Limestone Company	0	0.00E+00
MOG491139	Jasper Quarry	0	0.00E+00
MOG490063	Jasper Quarry	0	0.00E+00
MO0110272	Lamar Closed Sanitary Landfill	0	0.00E+00
MOG640014	Lamar Municipal DWTP	0	0.00E+00
MO0138592	Lamarti's Truck Stop	0	0.00E+00
MOG350161	MFA Oil Bulk Plant Golden City	0	0.00E+00
MOG350160	MFA Oil Bulk Plant Jasper	0	0.00E+00
Dry Fork (3189)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MOG350350	Fuel Marketing Corp Jasper Facility	0	0.00E+00
Opossum Creek (3190)			
Permit No.	Facility Name	<i>E. coli</i> Target Concentration (cfu/100 mL)	WLA (cfu/ day)
MOG350160	MFA Oil Bulk Plant Jasper	0	0.00E+00

8.3 Concentrated Animal Feeding Operations

All CAFO facilities in the Spring River watershed are subject to permit conditions that do not allow discharge directly or during land application. For this reason, the *E. coli* wasteload allocations for CAFO facilities is zero at all flows. A wasteload allocation of zero is the most stringent allocation that can be assigned and indicates the need for 100% pollutant reduction from any contributing sources of this type. This wasteload allocation applies to all CAFO facilities identified in Table 9, as well as any future CAFO facilities (including any existing or future AFOs that become permitted).

8.4 Municipal Separate Storm Sewer Systems

Potential load contributions for MS4s were calculated based on the relative area of the watershed contributing to MS4s. Areas potentially draining to MS4s account for approximately 7.3 square miles, or 0.62% of the entire Spring River (3160) watershed. No other water bodies addressed by this TMDL have MS4s in their watershed. The aggregated wasteload allocation for MS4s varies with stream flow and was calculated by multiplying the total loading capacity for the Spring River (3160) watershed by the relative area within the watershed that contributes to a MS4. If the area contributing to the MS4s expands or additional MS4 permits are required for stormwater discharges from other developed areas in the future, then the appropriate proportion of the load allocation, as it relates to stormwater pollutant contributions, may be re-assigned as a wasteload allocation without revision to this TMDL.

8.5 Other Stormwater Permitted Discharges

Facilities described in Section 5.1.5 that require stormwater permits that are not MS4 permits are not expected to contribute *E. coli* at loads or concentrations above negligible amounts to surface waters when all permit limits and conditions are met. Activities for which these permits are issued are expected to be conducted in compliance with all permit conditions, including any monitoring, stormwater pollution prevention plans, and discharge limitations. For these reasons, the *E. coli* wasteload allocations for these facilities are set to zero at all flows. Future general stormwater permitted activities that do not actively generate bacteria and that operate in full compliance with permit conditions are also not expected to contribute bacteria loads above negligible levels and not result in loading that exceeds the sum of the TMDL wasteload allocations.

8.6 Illicit Straight Pipe Discharges

Illicit straight pipe discharges are illegal and are not permitted under the federal Clean Water Act. For this reason, illicit straight pipe discharges are not allocated a portion of the available loading capacity and are assigned an *E. coli* wasteload allocation of zero. Any existing illicit straight pipe discharges must be eliminated, and future discharges of this type should be prevented.

9. Load Allocation (Nonpoint Source Load)

The load allocation is the portion of the loading capacity assigned to existing and future nonpoint sources and natural background contributions (40 CFR 130.2(g)). The load allocation for this TMDL is calculated as the remainder of the loading capacity after allocations to the wasteload allocation and the margin of safety, as presented in Section 7. The load allocations include contributions from agricultural lands, developed areas, and natural background contributions. No portion of the load allocations are assigned to onsite wastewater treatment systems because when they are properly maintained and operating as designed, they do not discharge *E. coli* directly to surface waters.

10. Margin of Safety

A margin of safety is required to account for uncertainties in scientific and technical understanding of water quality in natural systems (CWA Section 303(d)(1)(C) and 40 CFR 130.7(c)(1)). Based on EPA guidance (USEPA 2001), the margin of safety can be achieved through two approaches:

- Explicit - Reserve a portion of the loading capacity as a separate term in the TMDL.
- Implicit - Incorporate the margin of safety within the wasteload allocation and the load allocation calculations by making conservative assumptions in the analysis.

For this TMDL, both implicit and explicit margins of safety are used. Bacteria decay rates were not applied, and the direct recreational season geometric mean was used for estimating the daily loading value as required by the federal Clean Water Act. Additionally, domestic wastewater treatment facilities employing disinfection technologies operate to eliminate nearly all present pathogens rather than targeting a specific water quality criterion (target = 0 cfu/day). This results in pollutant loading much lower than assigned wasteload allocations. These conservative assumptions serve as implicit margins of safety and are applicable during all flow conditions. Additionally, for water bodies designated for whole body contact recreation category B or only having secondary contact recreation, TMDL targets are based on the more stringent criterion applicable for category A. This approach provides added confidence that downstream waters, where the more stringent criterion does apply, are protected, and, at the same time, requires additional pollutant reductions beyond that

needed for attainment of the category B use. During low flow periods, some streams are effluent dominated under design flow conditions and the wasteload allocation is equal to the available loading capacity. During these infrequent low flow periods, permitted effluent limits and disinfection technologies serve as the necessary implicit margin of safety. At all other flow conditions, an explicit margin of safety equal to 10% of the loading capacity is also applied.

Through the department's assessment methodologies and approach for development of this TMDL, effort was made to reduce overall uncertainty in the analyses. A majority of the *E. coli* samples collected over the last ten years were analyzed using an enzyme-specific media (Idexx/Colilert method). This method helps reduce variability, thus resulting in a more accurate and higher *E. coli* yield as compared to if conventional culture media are used. Finally, when calculating the load duration curves, the department used verified measured flow data from USGS gage stations. Together these data were used to provide estimates of existing loading from which pollutant reduction targets can be derived.

With these reductions of uncertainty, along with the implicit margins of safety outlined above, the department feels the use of an explicit margin of safety of ten percent sufficiently and adequately accounts for any other unspecified uncertainties or unknowns. Reserving a portion of the available loading capacity as an explicit margin of safety only further ensures that water quality standards will be achieved when all wasteload and load allocations are achieved.

11. Seasonal Variation

Federal regulations at 40 CFR 130.7(c)(1) require that TMDLs take into consideration seasonal variation in applicable water quality standards. The load duration curves provide the *E. coli* loading capacities for each water body at all possible flow regimes using data collected during all seasons. The *E. coli* TMDLs are therefore protective of designated uses during critical conditions throughout the recreational season, including during high flows associated with intense rainfall events when bacteria loading is more likely.

12. Monitoring Plans

The department conducts water quality monitoring in impaired waters within a reasonable timeframe following the approval of TMDLs, completion of facility upgrades and permit compliance schedules, or the implementation of watershed BMPs. The department will also routinely examine any available quality-assured water quality data collected by other local, state, and federal entities in order to assess the effectiveness of TMDL implementation. In addition, certain quality-assured data collected by universities, municipalities, private companies, and volunteer groups may be used to assess water quality following TMDL implementation.

13. Reasonable Assurance

Section 303(d)(1)(C) of the federal Clean Water Act requires that TMDLs be established at a level necessary to implement applicable water quality standards. As part of the TMDL process, consideration must be given to the assurances that point and nonpoint source allocations will be achieved, and water quality standards attained. Where TMDLs are developed for waters impaired by point sources only, reasonable assurance is provided through the NPDES permitting program. State operating permits requiring effluent and instream monitoring be reported to the department provide reasonable assurance that instream water quality standards will be met.

Where a TMDL is developed for waters impaired by both point and nonpoint sources, point source wasteload allocations must be stringent enough so that in conjunction with the water body's other loadings (i.e., nonpoint sources) water quality standards are met. Reasonable assurance that nonpoint sources will meet their allocated amount is dependent upon the availability and implementation of nonpoint source pollutant reduction plans, controls, or BMPs within the watershed. If BMPs or other nonpoint source pollution controls allow for more stringent load allocations, then wasteload allocations can be less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs (40 CFR 130.2(i)). When a demonstration of nonpoint source reasonable assurance is developed for an impaired water body, additional pollutant allocations for point sources may be allowed provided water quality standards are still attained. If a demonstration of nonpoint source reasonable assurance does not exist, or it is determined that nonpoint source pollutant reduction plans, controls, or BMPs are not feasible, durable, or will not result in the required load reductions, then allocation of greater pollutant loading to point sources cannot occur.

Primarily, reasonable assurance is provided through the watershed based plan described in the following section that targets voluntary implementation of BMPs to reduce nonpoint source pollution. In addition to the 319 grant funds the department provides for such projects, there are other mechanisms for addressing nonpoint source pollution. The Soil and Water Conservation Program is a cost-share program supported by the one-tenth-of-one percent Parks, Soils and Water Sales Tax. Appendix I further describes the program and the *E. coli* effective BMPs that have been installed in the watershed from 2019 through 2023. Many of the BMPs listed will continue to be effective into the future and the program will continue to help install more BMPs. This adds to the reasonable assurance that LA will be met.

As described in Section 5.2.3 DHSS sets standards for OWTS under 3,000 GPD while local governments like counties and municipalities can set even stricter regulations for OWTS. Permits for constructing and upgrading OWTS are often issued through county health departments and work to enforce DHSS standards that have been in place since 1996. This helps provide reasonable assurance that OWTS have local authorities working to limit failing systems and assure new systems are built to standards designed to reduce pollution.

13.1. The Spring River Watershed Based Plan

The previously accepted watershed based plan that encompasses the Spring River watershed as defined by this TMDL provides reasonable assurance that water quality standards will be attained. Before the development of this TMDL, there have been multiple watershed projects in the larger Spring U.S. Geological Survey (USGS) 8-digit HUC 11070207 watershed. The Spring River Nonpoint Source Watershed Plan (Watershed Plan) applies to the Missouri portion of the 8-digit HUC 11070207 and was developed in 2015 to meet the guidelines of the EPA Nine Key Elements Watershed Plan with the use of 319 funds. The Plan was accepted by the EPA in 2018 (MoDNR 2023). The Watershed Plan summary with links to access the entire plan is available on the department website.³⁰ Pollutants targeted by the plan are nutrients, including phosphorus and nitrogen, sediment, and bacteria. Development of the Watershed Plan was done by Kansas State University in collaboration with the Missouri Department of Natural Resources Watershed Protection Section, University of Missouri Extension, and the Harry S. Truman Coordinating Council. The Watershed Plan serves as an overall strategy to guide watershed restoration and

³⁰ Spring River Watershed Plan Summary available at <https://dnr.mo.gov/document-search/spring-river-watershed-management-plan-summary-pub3065/pub3065>.

protection efforts by stakeholders that can include individuals, non-governmental organizations, local, state, and federal agencies. The focus of the plan is on reducing nonpoint source pollution in the watersheds of impaired water body segments. To do this, it outlines BMPs can reduce runoff carrying sediment, nutrients, and bacteria. Furthermore, high priority subwatersheds are designated for BMP implementation first. Approximately 70% of the Spring River watershed is considered part of the high priority subwatersheds designated in the Watershed Plan. Appendix H will further discuss high priority areas for BMP implementation.

Though the Watershed Plan does not fully address point sources, it does mention point sources as possible sources of pollutants in the watershed. One goal of this TMDL is to characterize the pollutant contributions from point sources relating to *E. coli* in the Spring River (3160) watershed and its impaired subwatersheds. It must also be noted that implementation of BMPs recommended in the Watershed Plan is voluntary; not a requirement on the part of landowners.

At the time the Watershed Plan was written, the objectives were to directly address the sediment impairment in the North Fork Spring River subwatershed, the bacteria impairments of 22 individual WBIDs, and the nutrient impairments in Clear Creek and North Fork Spring River subwatersheds. Prior to the development of the Watershed Plan, a TMDL was written for the sediment impairment in the North Fork Spring River (3188) and was approved in 2006³¹. In 2018, an addendum to the plan was developed and 12 bacteria impaired water bodies were added to the Watershed Plan. 18 out of the now 34 bacteria impairments addressed by the Watershed Plan after the addendum are being addressed by this TMDL. All bacteria impaired segments addressed by this TMDL are shown in the Water Body Summary with their year listed on the 303(d) list.

In recent years, organizations such as Land Learning Foundation (LLF), Missouri State University's Ozarks Environmental and Water Resources Institute (OEWR), The Nature Conservancy (TNC), MidwestWaters.Org (Midwest Waters), and the Harry S Truman Coordinating Council (HSTCC) have partnered to improve water quality in the Spring River watershed. Ongoing work in line with the Watershed Plan includes water quality sampling, streambank stabilization, riparian restoration, wetland restoration, establishment of conservation easements, and livestock exclusion. As of 2024, the department is updating the Watershed Plan per EPA requirements with the help of organizations working within the watershed. The updated plan will also include the LAs developed by this TMDL to serve as nonpoint source loading targets for watersheds addressed by both this TMDL and the updated Watershed Plan.

Although not all related to the Watershed Plan, there has been BMP implementation within the watershed that is helping to reduce *E. coli* loading from agricultural lands. Over the past five years, approximately 20,687 acres have had at least one BMP installed, with help from the Soil and Water Conservation Program (SWCP), with the goal to reduce *E. coli* loading. See Appendix I and Table 92I for a breakdown of practices installed by year.

Information regarding potential funding sources, cost-share opportunities, and implementation actions that address nonpoint source loading are available in the Spring River Nonpoint Source Watershed Plan.

³¹North Fork Spring River (3188) Sediment TMDL available at <https://dnr.mo.gov/document-search/north-fork-spring-river-sediment-total-maximum-daily-load>.

14. Public Participation

EPA regulations at 40 CFR 130.7 require that TMDLs be subject to public review. A 45-day public notice period for this TMDL report will be held from June 20, 2025, through August 4, 2025.

Groups that directly received notice of the public comment period include, but are not limited to:

- Missouri Clean Water Commission
- Kansas Department of Health and Environment
- Oklahoma Department of Environmental Quality
- Missouri Department of Conservation
- Missouri Department of Natural Resources Southwest Regional Office
- Southwest Missouri Council of Governments
- County Soil and Water Conservation Districts
- County health departments
- County commissions
- Harry S. Truman Council of Governments
- University of Missouri Extension
- Missouri Coalition for the Environment
- Missouri Farm Bureau
- Stream Teams United
- Stream Team volunteers living in or near the watershed; and
- Missouri state legislators representing areas within the watershed.
- Quapaw Nation
- Peoria Tribe of Indians of Oklahoma
- Ottawa Tribe of Oklahoma
- Eastern Shawnee Tribe of Oklahoma
- Wyandotte Nation
- Cherokee Nation

In addition to those groups directly contacted about the public notice, this TMDL report will be posted on the department's TMDL webpage at: dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls. All comments received during this period and the department's responses to those comments will also be made available at this location for 30 days after submittal or until EPA approval, whichever is longer.

The department maintains an email distribution list for notifying subscribers of significant TMDL updates or activities, including public notices and comment periods. Those interested in subscribing to TMDL updates can submit their email address using the online form available at: public.govdelivery.com/accounts/MODNR/subscriber/new?topic_id=MODNR_177.

15. Administrative Record and Supporting Documentation

The department has an administrative record on file for the Spring River watershed *E. coli* TMDL. The record contains information on which the TMDL is based. It additionally includes the TMDL public notice announcement, any public comments received, and the department's responses to those comments. This information is available upon request to the department at: dnr.mo.gov/open-records-sunshine-law-requests. The department will process any request for information about this

TMDL in accordance with Missouri's Sunshine Law (Chapter 610, RSMo) and the department's administrative policies and procedures governing Sunshine Law requests.

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Appendix A: *E. coli* Data Report

Due to the large number of samples for all 18 impaired segments, all sample data are presented in a supplemental *E. coli* Data Report document available online at <https://dnr.mo.gov/document-search/all-available-e-coli-sample-data-spring-river-watershed-tmdl>.

Appendix B: Development of *E. coli* Load Duration Curves

Overview

Load duration curves were used to develop the *E. coli* TMDLs for the impaired stream segments in the Spring River watershed. Load duration curves visually display the loading capacity of a water body at all possible flows based on historical flow data and the defined target concentration for each pollutant. For these TMDLs, a portion of the *E. coli* loading capacity is assigned as a wasteload allocation based on the individual design flows of domestic wastewater treatment facilities present in the watershed. Ten percent of the loading capacity is reserved as an explicit margin of safety. For some waters, at certain extreme low flows that are frequently exceeded only implicit margins of safety are applicable.

Methodology

Load duration curves are based on flow duration curves developed using a long-term time series of daily flows and a numeric water quality target. Average daily flow data that are representative of the impaired segment are used to develop the flow duration curve. If sufficient flow records for the impaired stream segment are not available, then flow data collected from a gage in a representative watershed may be used, or a flow duration curve can be derived by synthesizing long-term flow data from several gages within the same ecological drainage unit.

At four of the impaired segments there is a USGS stream gage on the water body to provide daily flow data. Mean daily discharge data were area corrected based on the proportion of the impaired segment watershed to the drain area of the USGS stream gage. The resulting ratio would be considered representative if it were within a 0.5 to 1.5 range. Seven of the impaired segments have load duration curves developed using representative flow measured at other USGS stream gages throughout the Spring River watershed and larger Neosho ecological drainage unit. All of these gages and their area correction to the impaired watersheds are shown in Table 37B. Flow duration curves are shown in Figures 29B through 39B.

The remaining seven impaired stream segments are without an acceptable area-correction to a USGS stream gage within the Neosho ecological drainage unit. The load duration curves for these impaired segments are based on a flow duration curve derived by synthesizing 20 years of daily average flow data recorded at five USGS stream gages within the Neosho ecological drainage unit. Nash-Sutcliffe statistics are calculated for each gage flow record in order to determine if the relationship is valid for each record. The Nash-Sutcliffe statistic evaluates the efficiency of a predicted (modeled) flow dataset. An efficiency of 1 (100%) describes a perfect match, while values less than zero indicate a poor fit of modeled and observed datasets. This relationship must be valid in order to use the synthesized flow methodology (Nash and Sutcliffe 1970). Model estimates are considered satisfactory if Nash-Sutcliffe statistics are greater than 50% (Moriassi 2007). Once a valid relationship is confirmed and a synthetic flow regime is developed for a water body, any and all point source flows from within the watershed are added to the synthetic flow regime. Each gage used to derive the synthetic flow is listed in Table 38B with their Nash-Sutcliffe statistic. Note that they all score well above 50%. The flow duration curves for each reference stream and the resulting synthesized flow are depicted in Figure 40B. The synthesized flow duration curve was adjusted to the watershed areas of each impaired stream to produce the flow duration curves for each stream as displayed in Figures 41B through 47B. The mean, minimum, and maximum flows estimated for each stream addressed by this TMDL are shown in Table 39B.

For this TMDL, the loading capacity for each stream is based on concentration of 126 cfu/100 mL, average daily flows, and a conversion factor of 24,465,715 in order to generate the loading capacity in units of cfu/day. The total loading capacities for these streams is the sum of allowable loading in the watershed.

Table 37B. Information used for developing area corrected flow records³²

Watershed	WBID	Watershed Area (mi ²)	Flow Derived From	Gage Name	Gage No.	Gage Drain Area (mi ²)	Conversion Factor
Spring River	3160	1,179.47	Waterbody	Spring River near Waco, MO	07186000	1,164.0	1.0133
Dry Hollow Creek	3163	19.66	Synthetic	NA - Synthetic Flow	NA	NA	NA
Spring River	3164	215.35	Waterbody	Spring River at La Russell, MO	07185700	306.0	0.7038
Spring River	3165	66.75	Representative	Buffalo Creek at Tiff City, MO	07189100	60.8	1.0979
Spring River trib.	4112	3.86	Synthetic	NA - Synthetic Flow	NA	NA	NA
Honey Creek	3169	67.52	Representative	Buffalo Creek at Tiff City, MO	07189100	60.8	1.1105
Honey Creek	3170	11.39	Representative	Cave Springs Branch near South West City, MO	07189540	8.0	1.4233
Williams Creek	3171	54.44	Representative	Buffalo Creek at Tiff City, MO	07189100	60.8	0.8955
Williams Creek	3172	53.91					0.8866
Truitt Creek	3174	28.46	Synthetic	NA - Synthetic Flow	NA	NA	NA
Truitt Creek	3175	25.19					
White Oak Creek	3182	63.16	Representative	Buffalo Creek at Tiff City, MO	07189100	60.8	1.0389
North Fork Spring River	3186	641.40	Waterbody	North Fork Spring River near Purcell, MO	07185910	515.0	1.2454
North Fork Spring River	3188	374.47					0.7271
Dry Fork	3189	95.60	Representative	Big Sugar Creek near Powell, MO	07188653	141.0	0.6780
Opossum Creek	3190	14.17	Synthetic	NA - Synthetic Flow	NA	NA	NA
Duval Creek	3199	19.56					
Slater Branch	3754	3.49					

³² Flow data that were in provisional status at the time of this report were not used.



USGS gage at Spring River near Waco, MO – 07186000 at Maple Road. MoDNR file photo. September 2024

Table 38B. Stream Gages used to Develop Synthetic Flow, Nash-Sutcliffe

USGS Gage	Drainage Area (mi ²)	Period of Data	Nash-Sutcliffe (%)
USGS 07188653 Big Sugar Creek near Powell, MO	141.0	2/2004 - 2/2024	92%
USGS 07189100 Buffalo Creek at Tiff City, MO	60.8		66%
USGS 07188838 Little Sugar Creek near Pineville, MO	195.0	10/2004 – 2/2024	99%
USGS 07185700 Spring River at La Russell, MO	306.0	5/2007 – 12/2023	85%
USGS 07188885 Indian Creek near Lanagan, MO	239.0	1/2004 – 2/2024	85%
		Mean:	86%

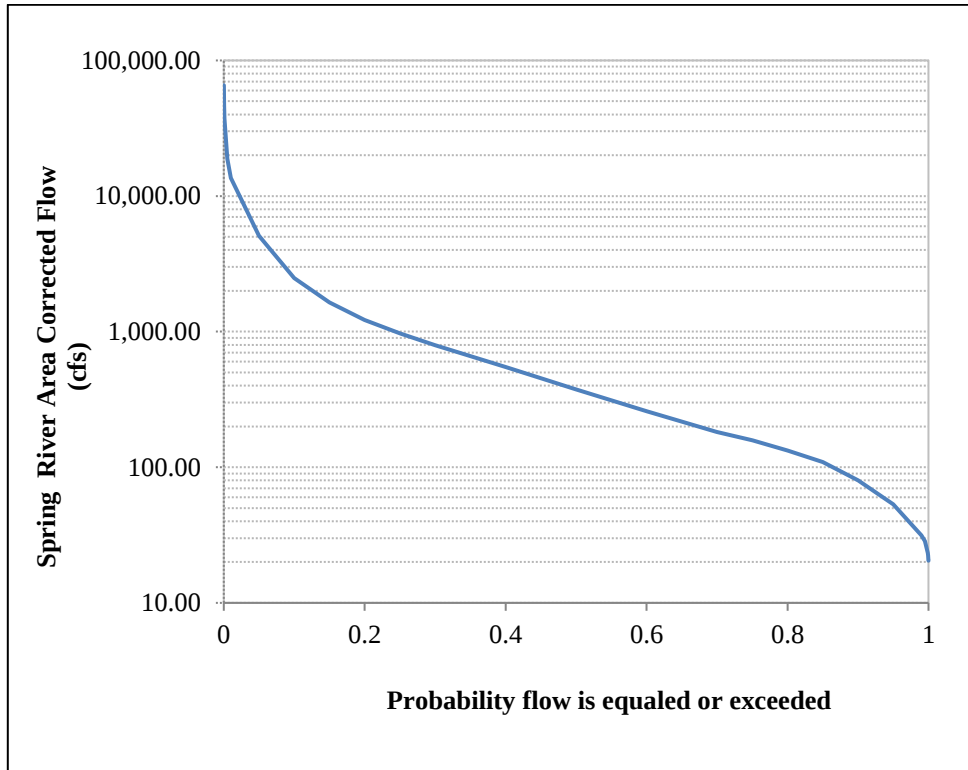


Figure 29B. Spring River (3160) Flow Duration Curve

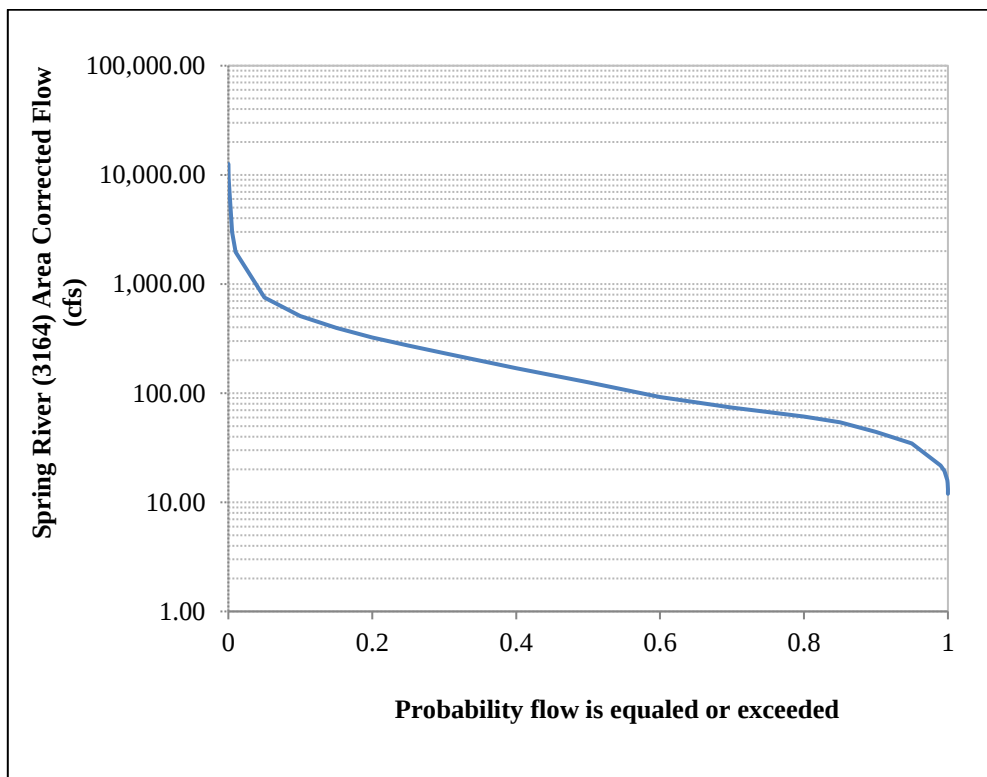


Figure 30B. Spring River (3164) Flow Duration Curve

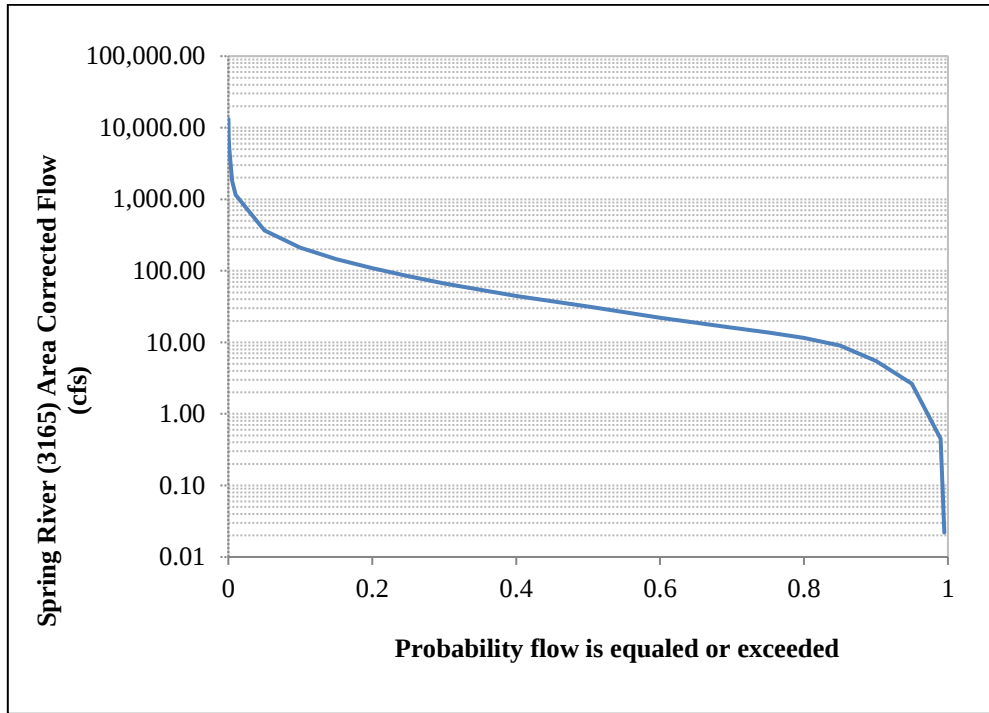


Figure 31B. Spring River (3165) Flow Duration Curve

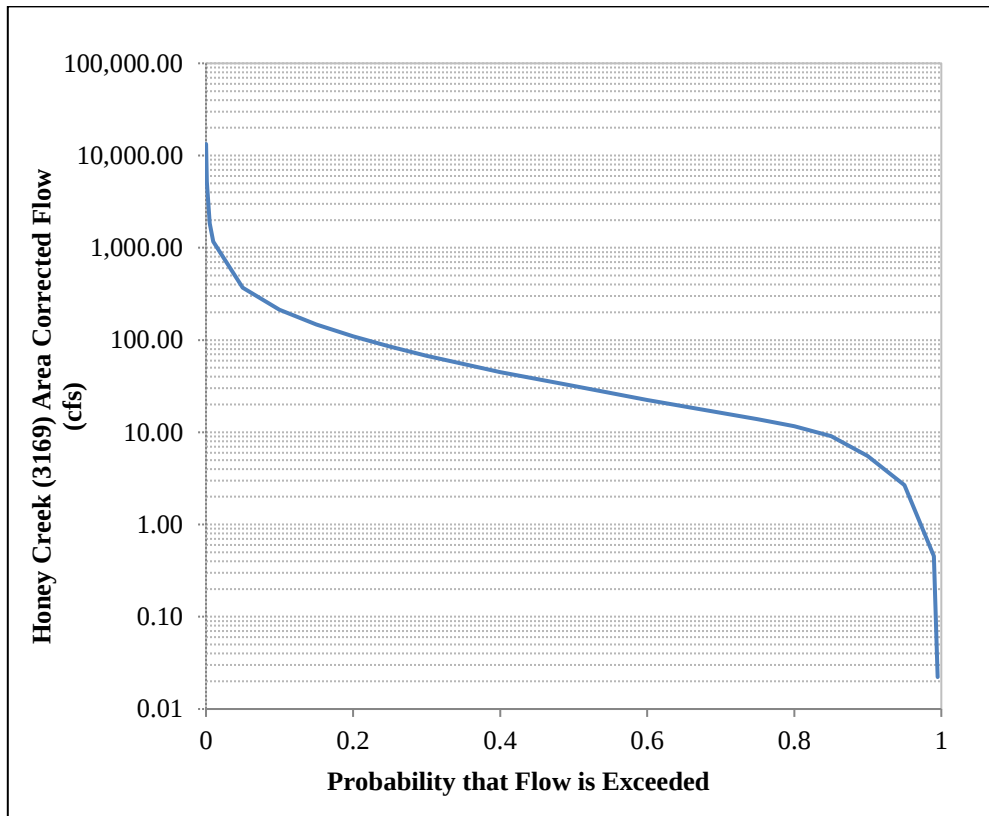


Figure 32B. Honey Creek (3169) Flow Duration Curve

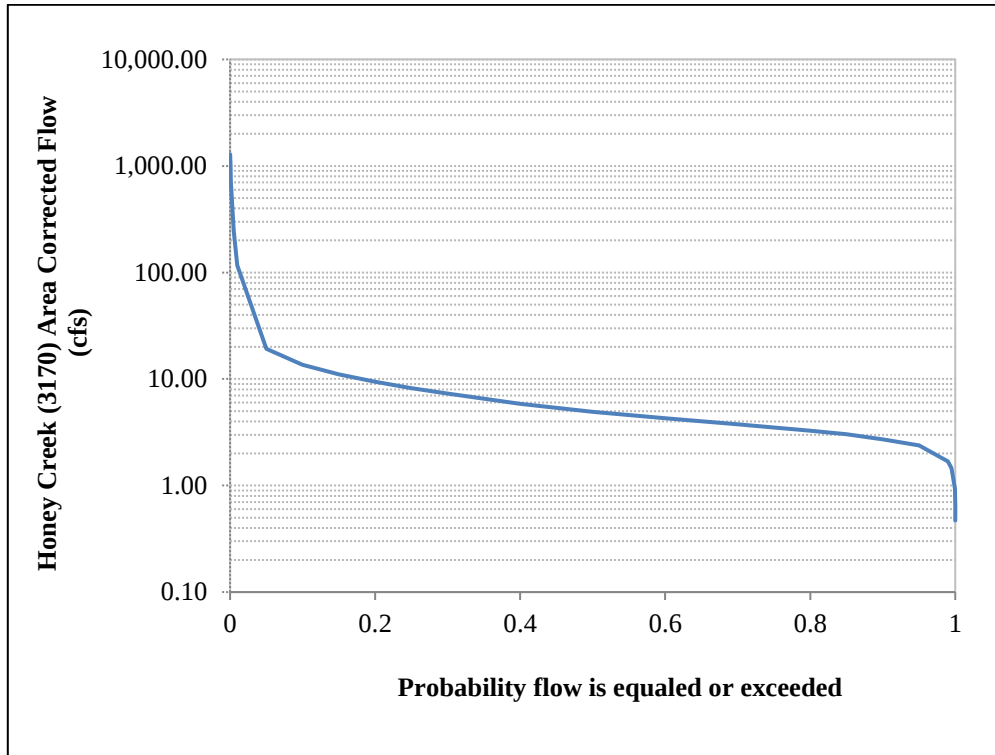


Figure 33B. Honey Creek (3170) Flow Duration Curve

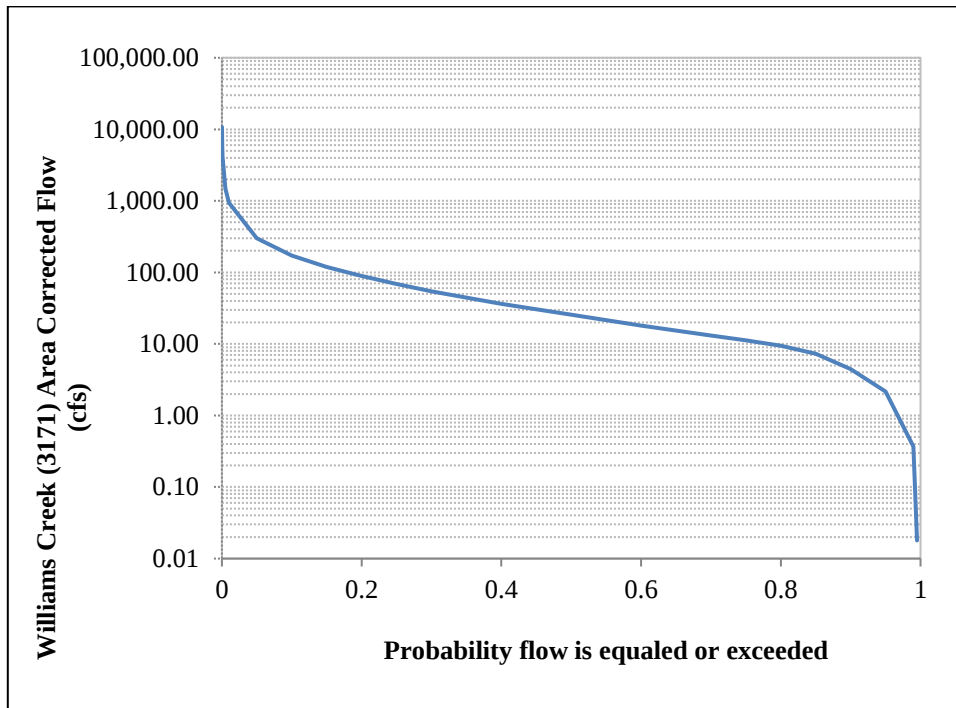


Figure 34B. Williams Creek (3171) Flow Duration Curve

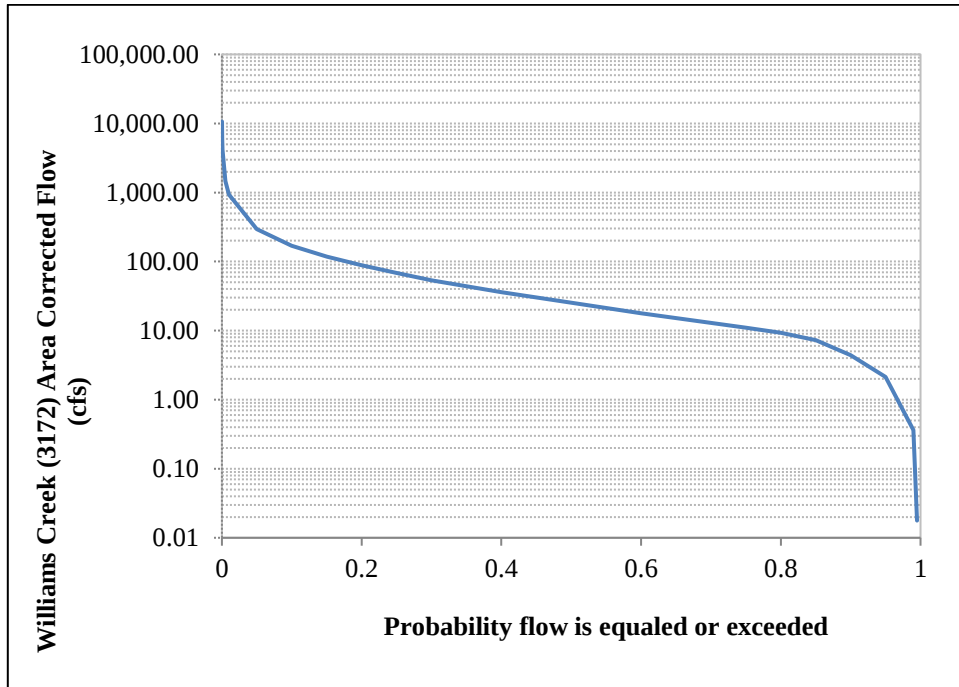


Figure 35B. Williams Creek (3172) Flow Duration Curve

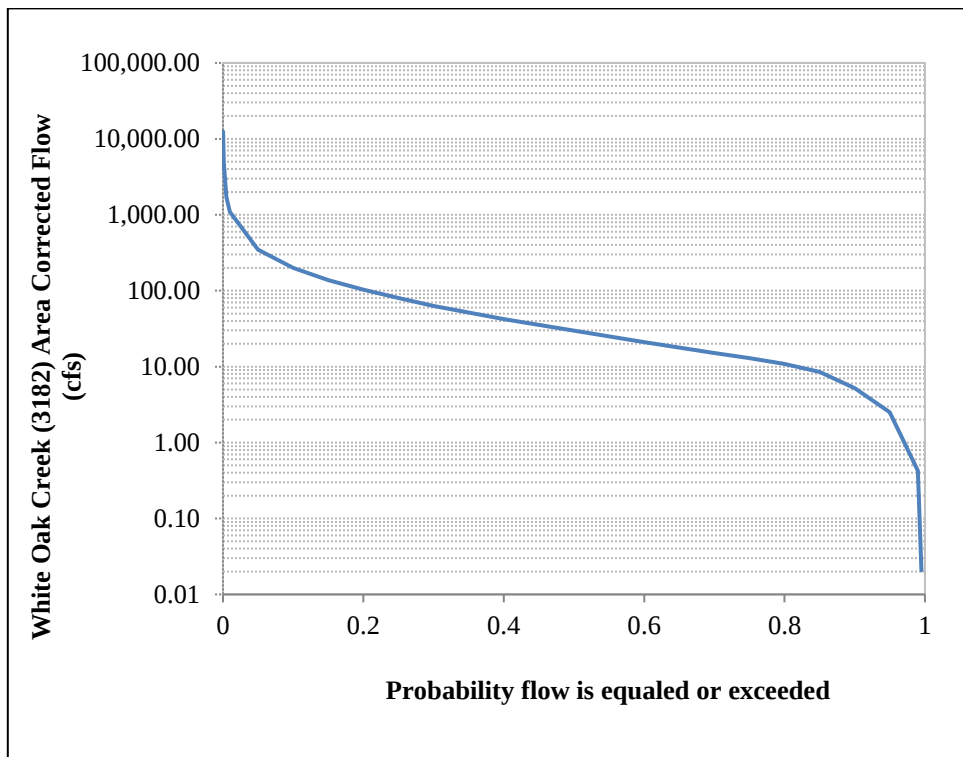


Figure 36B. White Oak Creek (3182) Flow Duration Curve

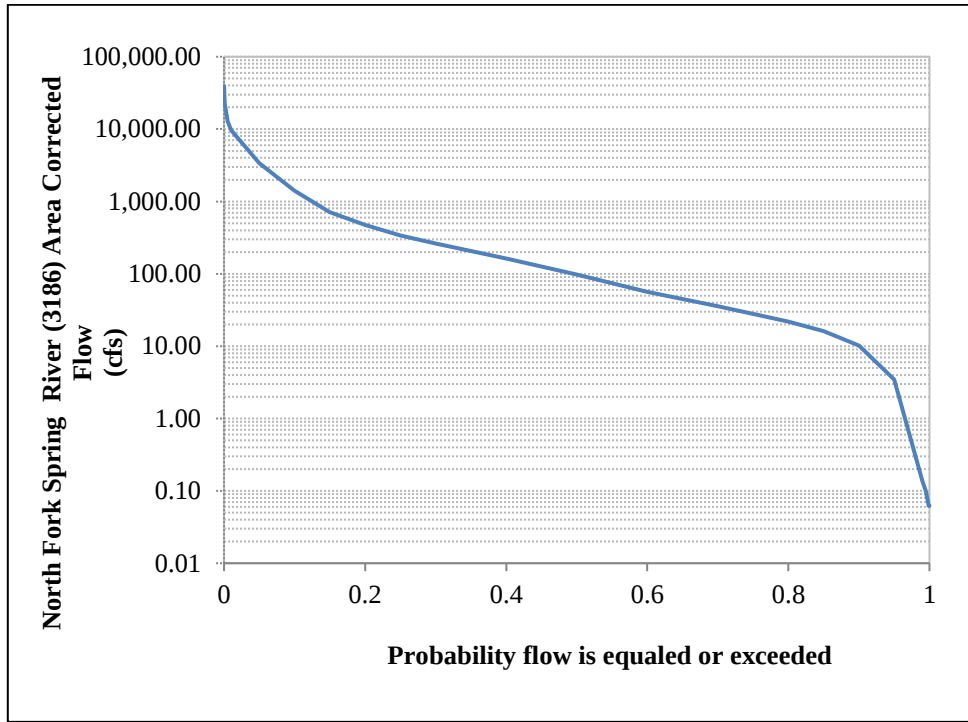


Figure 37B. North Fork Spring River (3186) Flow Duration Curve

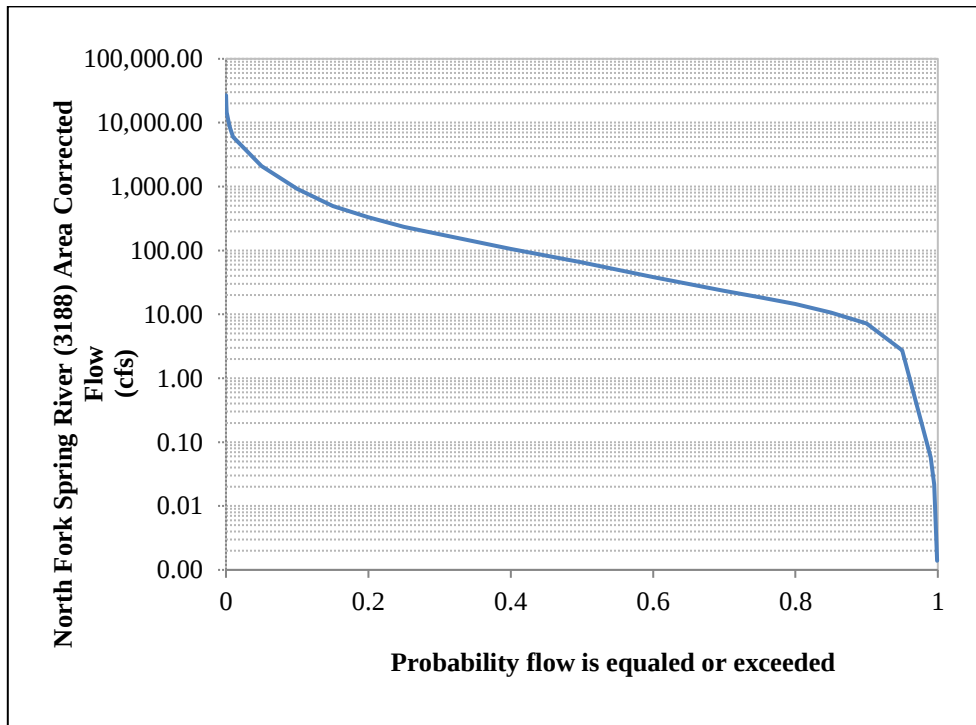


Figure 38B. North Fork Spring River (3188) Flow Duration Curve

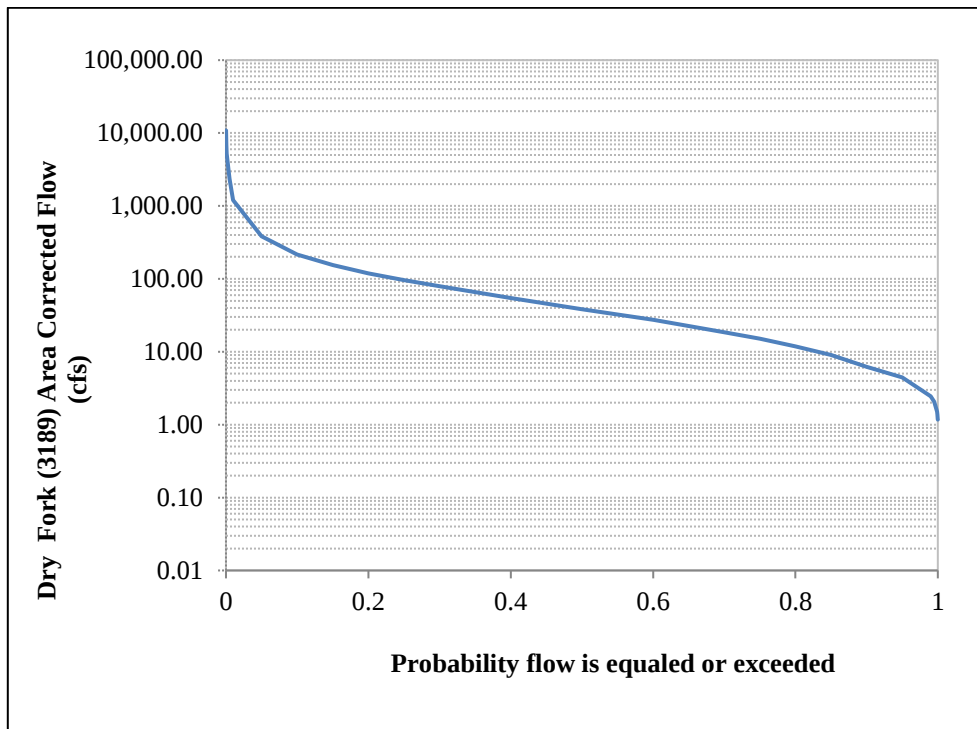


Figure 39B. Dry Fork (3189) Flow Duration Curve

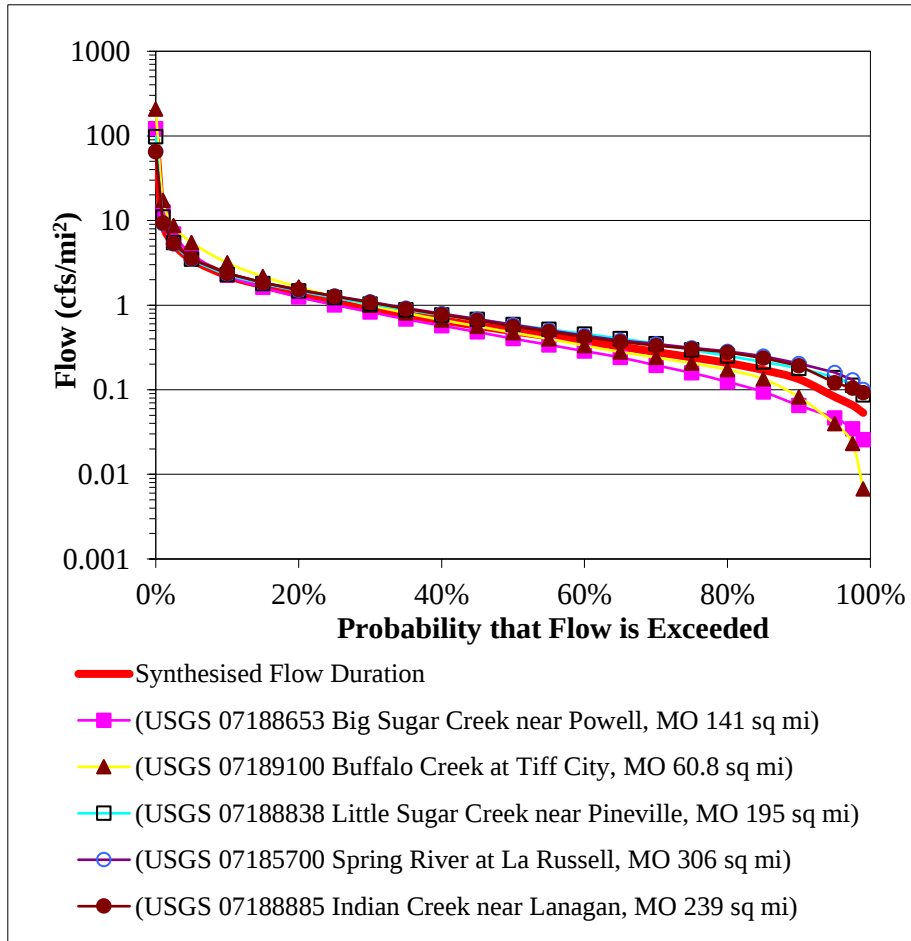


Figure 40B. Area-based Synthetic Flow Duration Curve

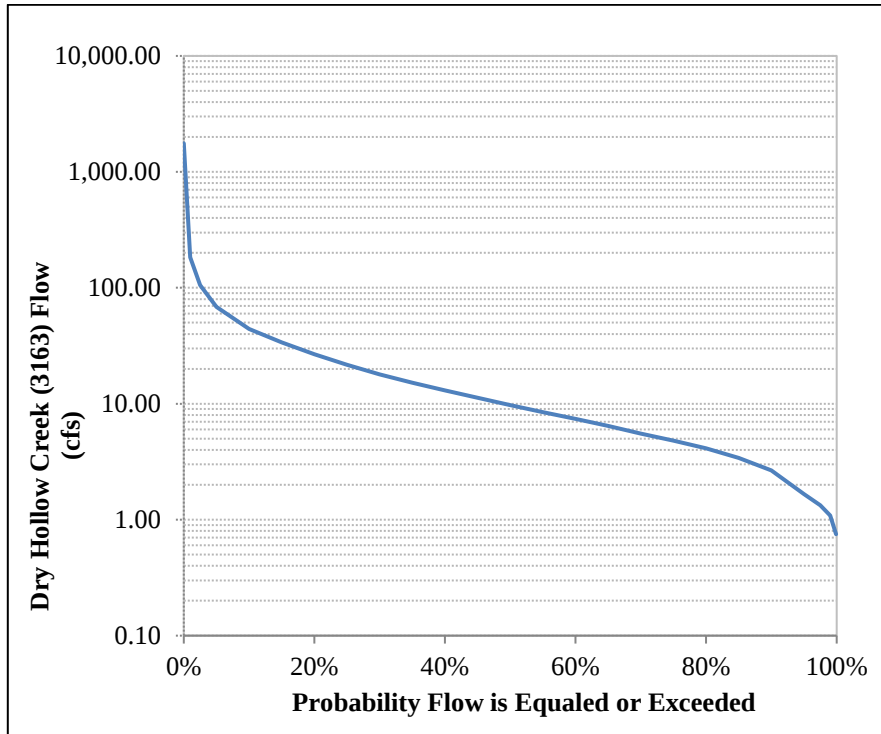


Figure 41B. Dry Hollow Creek (3163) Synthetic Flow Duration Curve

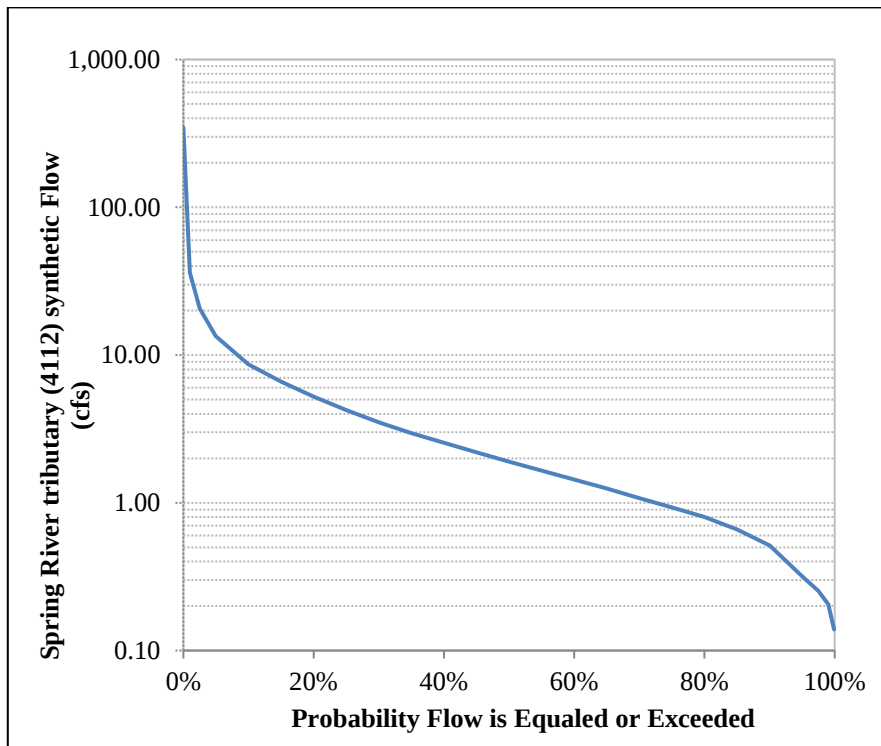


Figure 42B. Spring River tributary (4112) Synthetic Flow Duration Curve

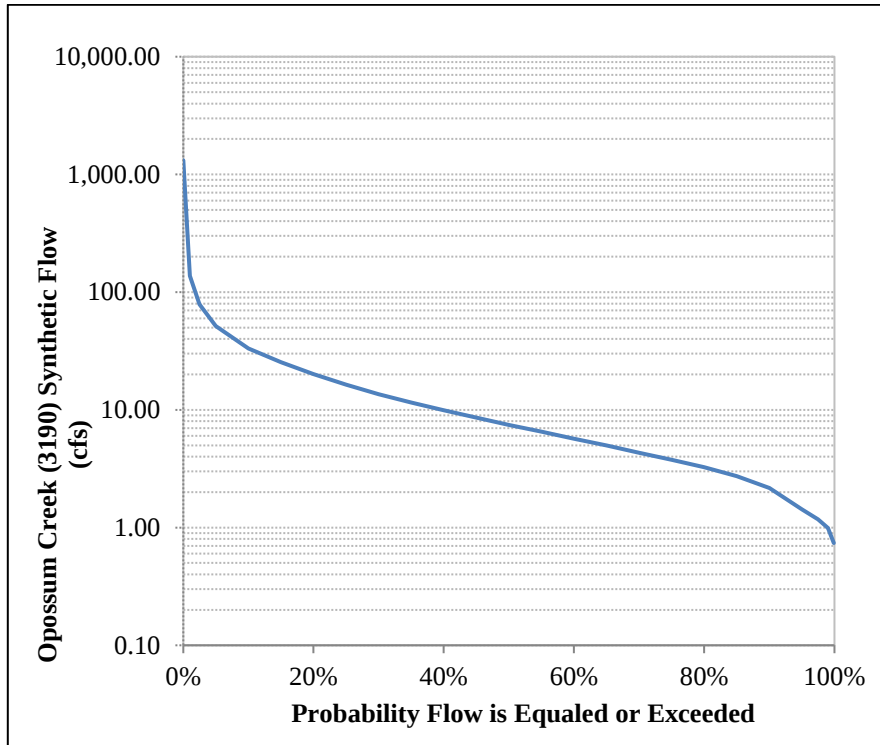


Figure 43B. Opossum Creek (3190) Synthetic Flow Duration Curve

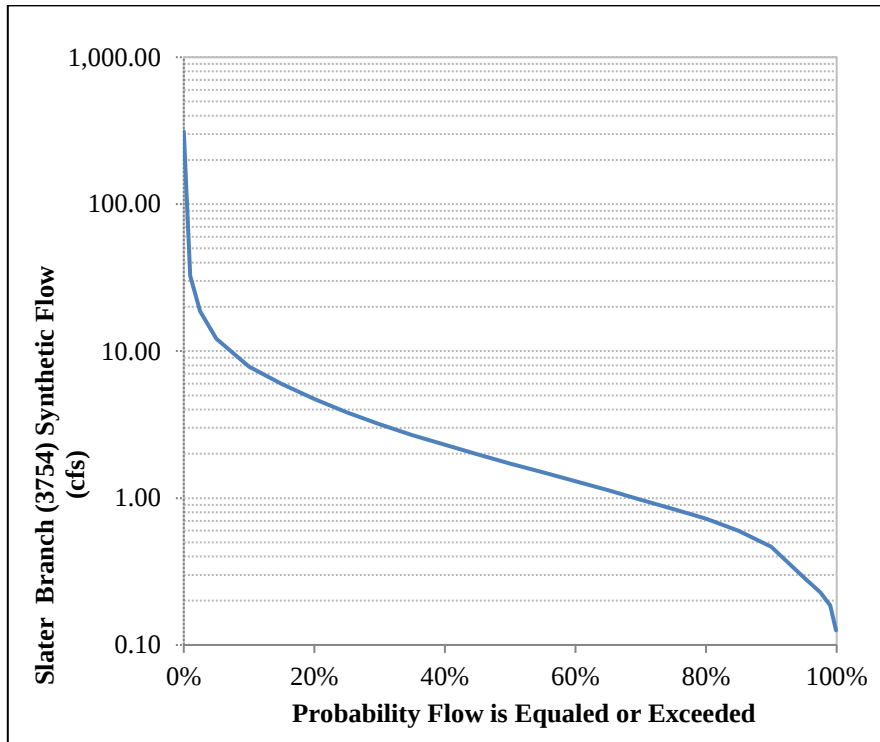


Figure 44B. Slater Branch (3754) Synthetic Flow Duration Curve

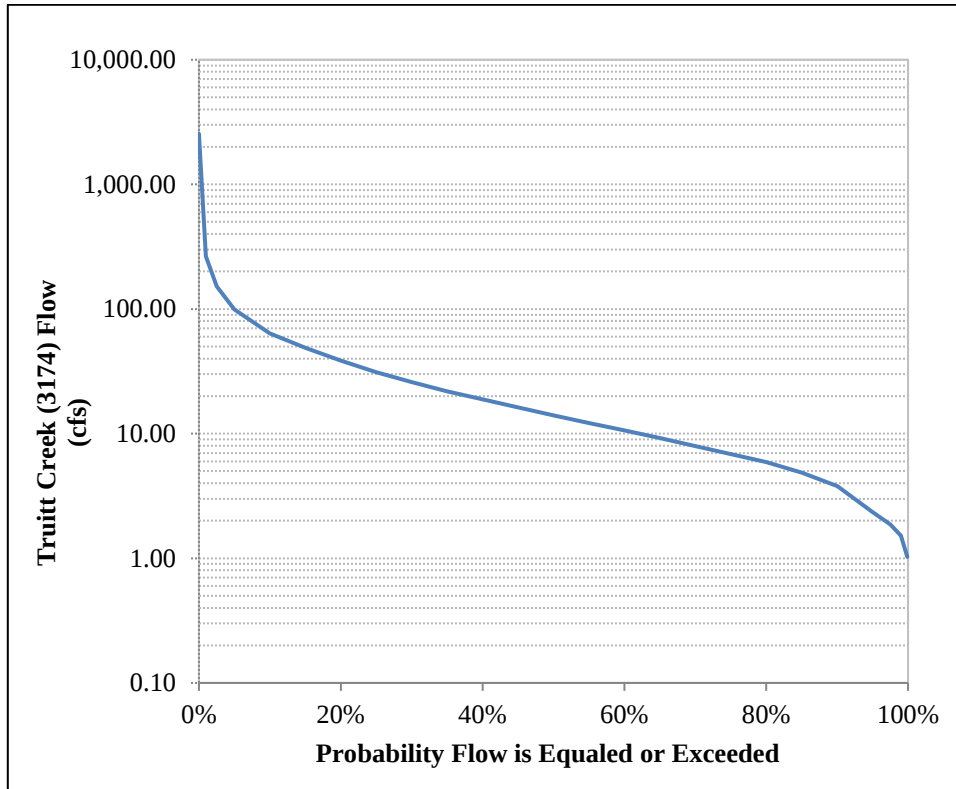


Figure 45B. Truitt Creek (3174) Synthetic Flow Duration Curve

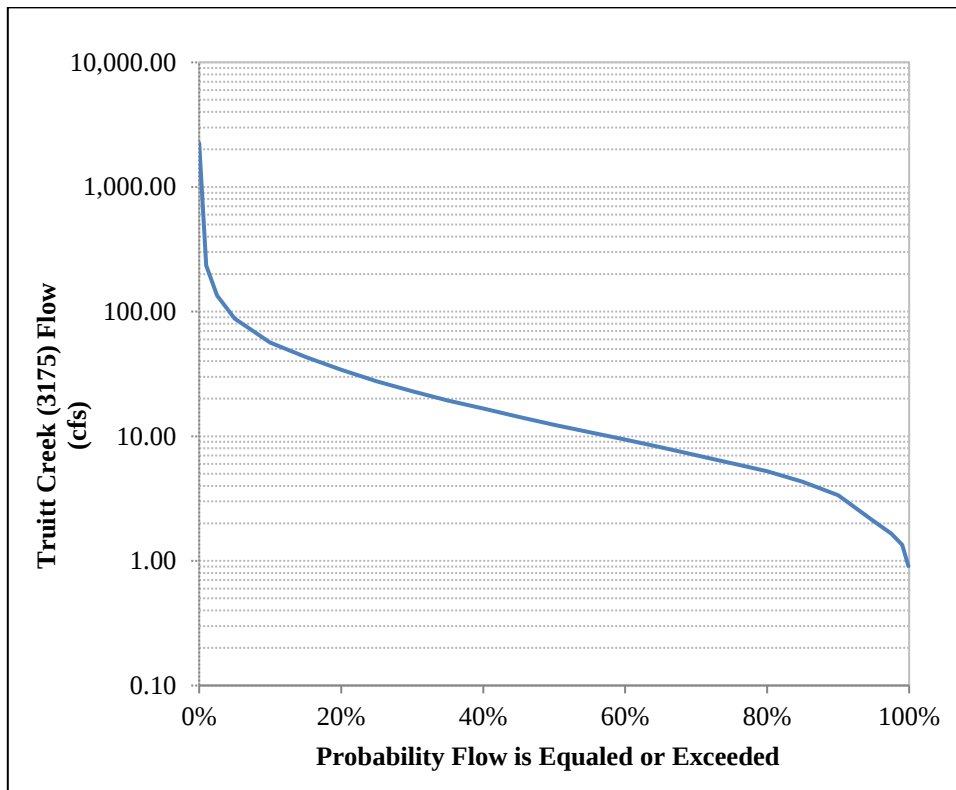


Figure 46B. Truitt Creek (3175) Synthetic Flow Duration Curve

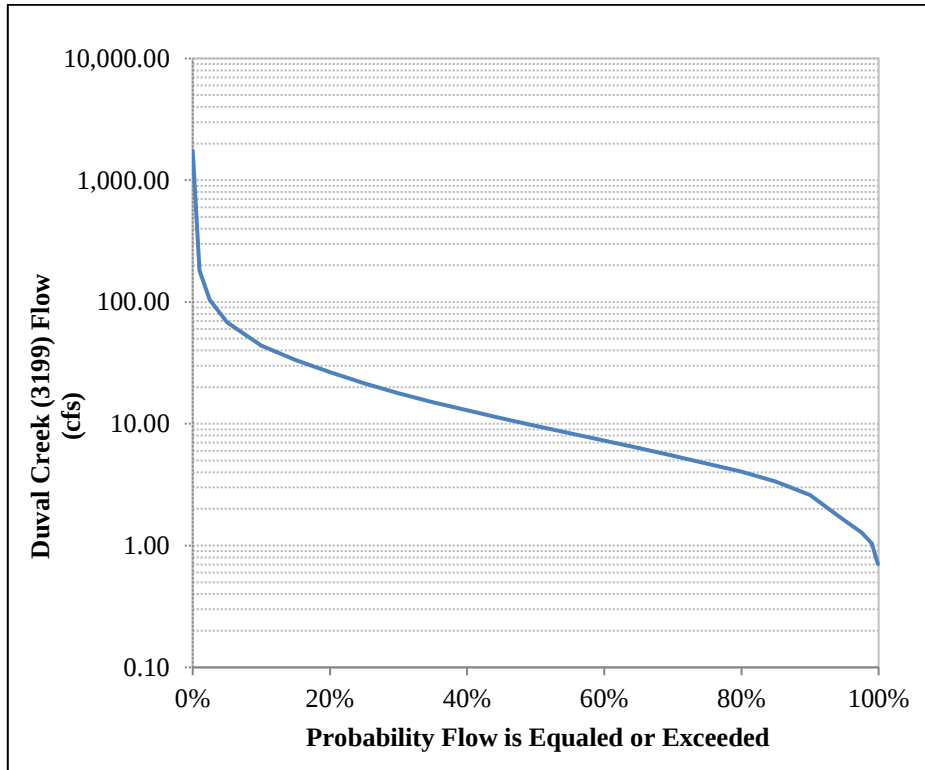


Figure 47B. Duval Creek (3199) Synthetic Flow Duration Curve

Table 39B. Mean, Minimum, and Maximum Estimated Daily Average Flows

WBID	Waterbody Name	Flow (ft ³ /s)		
		Mean	Minimum	Maximum
3160	Spring River	1,210.31	20.47	75,996.97
3163	Dry Hollow Creek	22.05	0.71	1,759.66
3164	Spring River	253.46	11.96	14,004.72
3165	Spring River	104.65	0.00	13,833.06
4112	Spring River tributary	4.32	0.13	344.96
3169	Honey Creek	105.86	0.00	13,992.42
3170	Honey Creek	10.78	0.47	1,313.66
3171	Williams Creek	85.36	0.00	11,282.78
3172	Williams Creek	84.52	0.00	11,171.72
3174	Truitt Creek	31.86	0.97	2,547.00
3175	Truitt Creek	28.19	0.86	2,253.76
3182	White Oak Creek	99.03	0.00	13,090.05
3186	North Fork Spring River	648.19	0.06	43,590.35
3188	North Fork Spring River	378.40	0.00	25,449.49
3189	Dry Fork	114.48	1.17	11,661.73
3190	Opossum Creek	16.68	0.71	1,316.80
3199	Duval Creek	21.89	0.67	1,749.87
3754	Slater Branch	3.90	0.12	312.12

Appendix C: *E. coli* Geometric Means by Month Figures

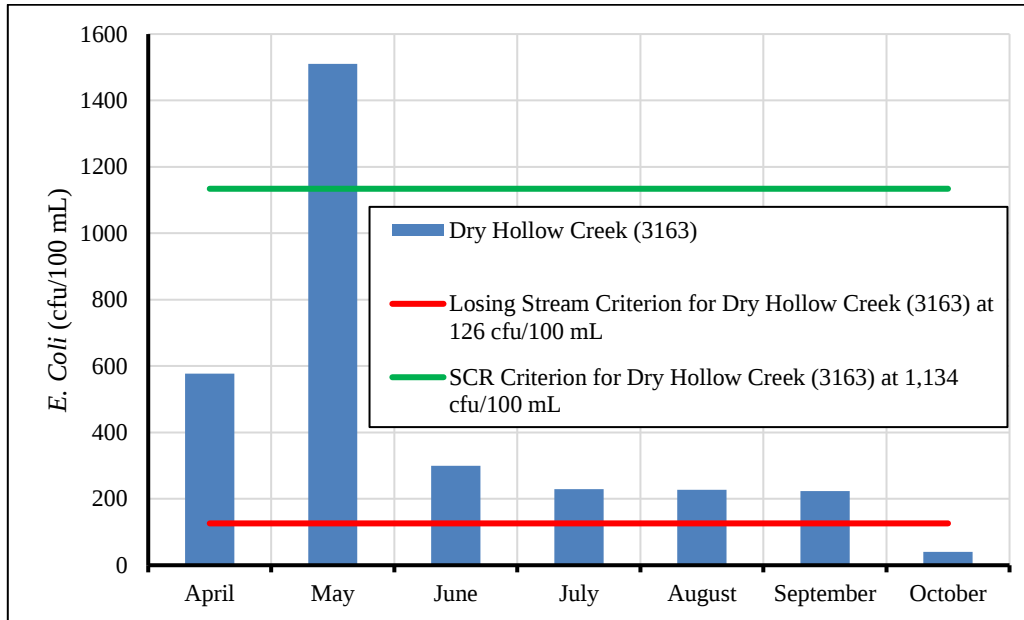


Figure 48C. Geometric means of *E. coli* samples by month from 2007, 2010-2012, and 2020-2023 in Dry Hollow Creek (3163)

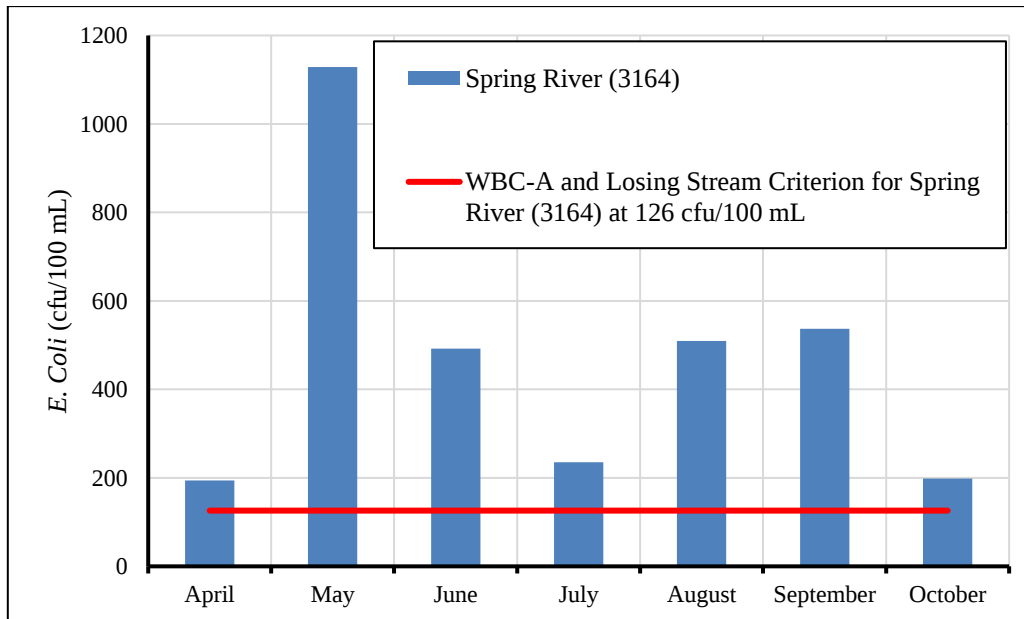


Figure 49C. Geometric means of *E. coli* samples by month from 2007, 2012-2013, and 2023 in Spring River (3164)

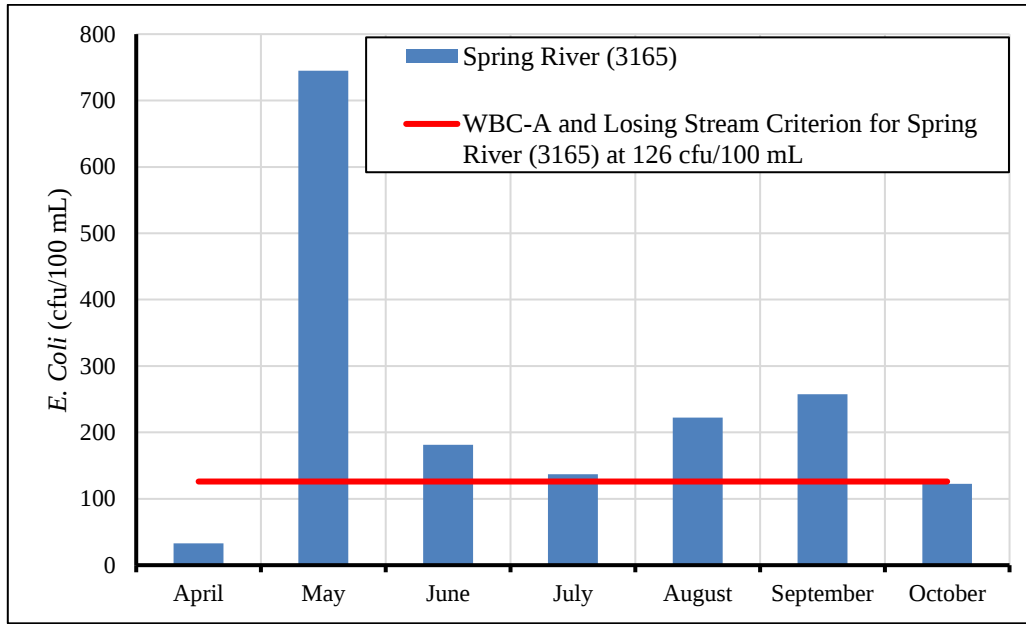


Figure 50C. Geometric means of *E. coli* samples by month from 2007, 2008, 2010-2013, and 2023 in Spring River (3165)

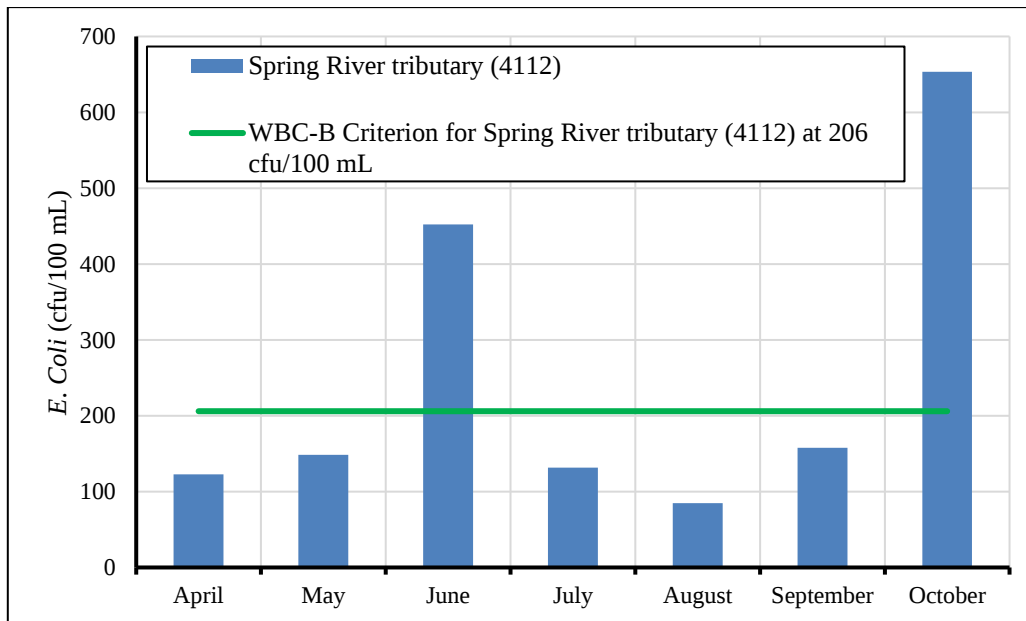


Figure 51C. Geometric means of *E. coli* samples by month from 2010, and 2011 in Spring River tributary (4112)

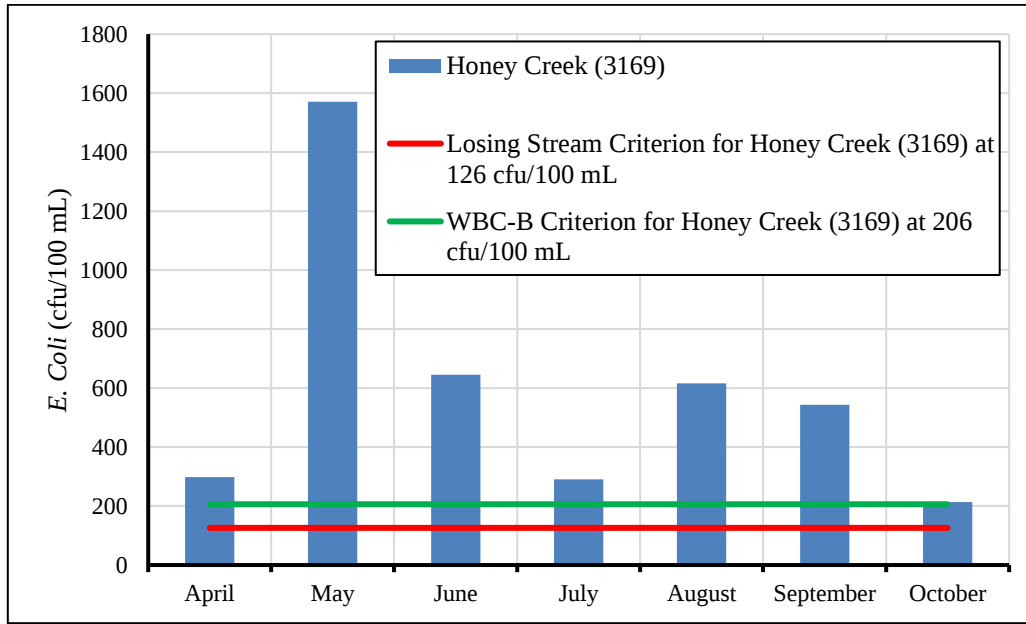


Figure 52C. Geometric means of *E. coli* samples by month from 2007, 2008, 2010-13, and 2023 in Honey Creek (3169)

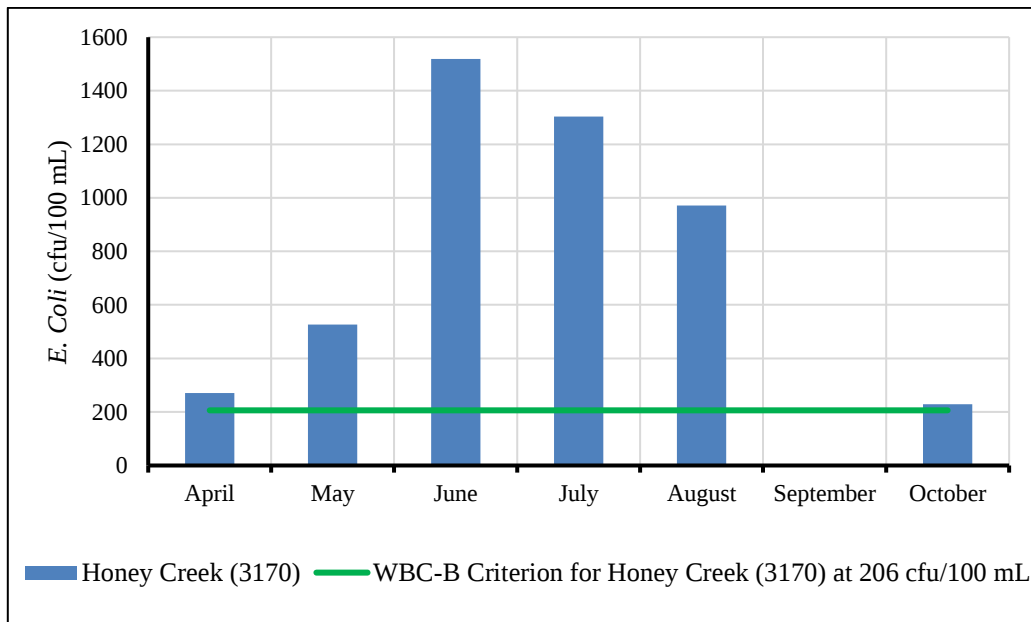


Figure 53C. Geometric means of *E. coli* samples by month from 2007, 2010, 2013, and 2023 in Honey Creek (3170)

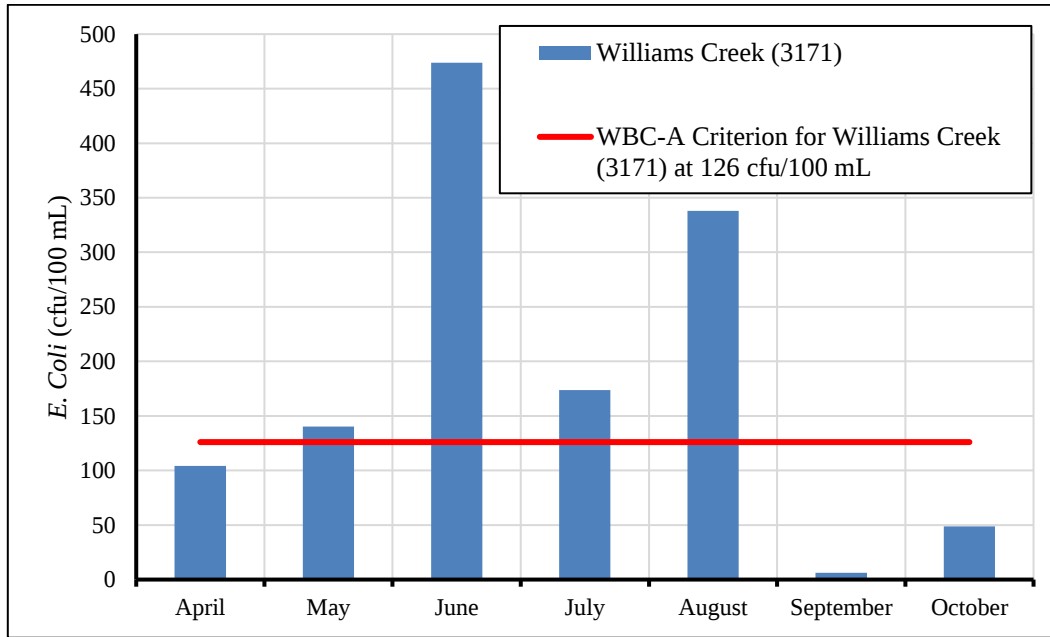


Figure 54C. Geometric means of *E. coli* samples by month from 2007, 2015, and 2023 in Williams Creek (3171)

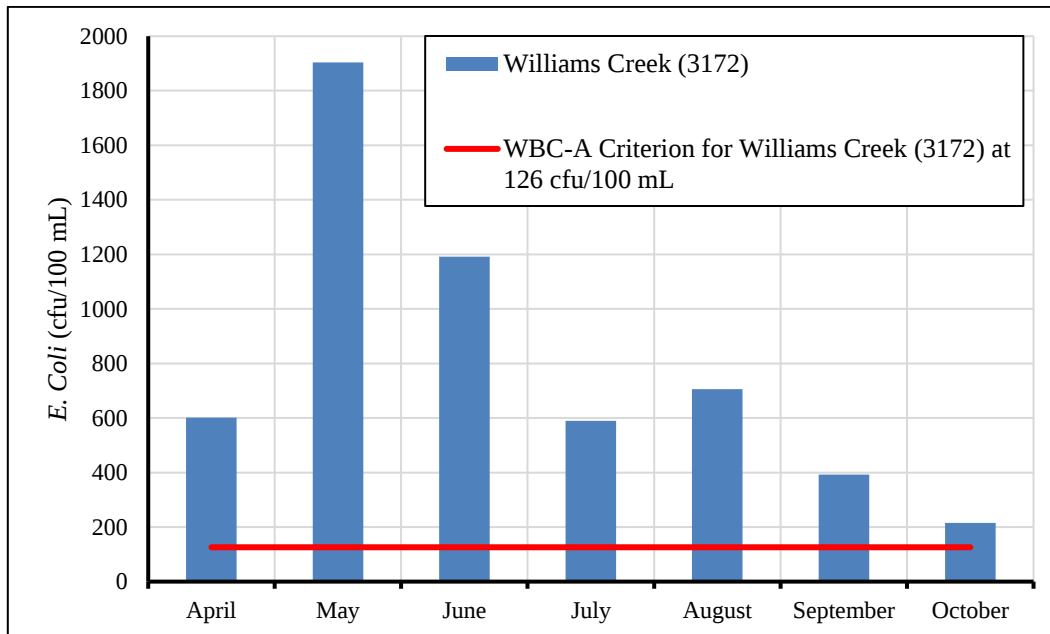


Figure 55C. Geometric means of *E. coli* samples by month from 2007, 2008, 2010-2013, 2015, and 2023 in Williams Creek (3172)

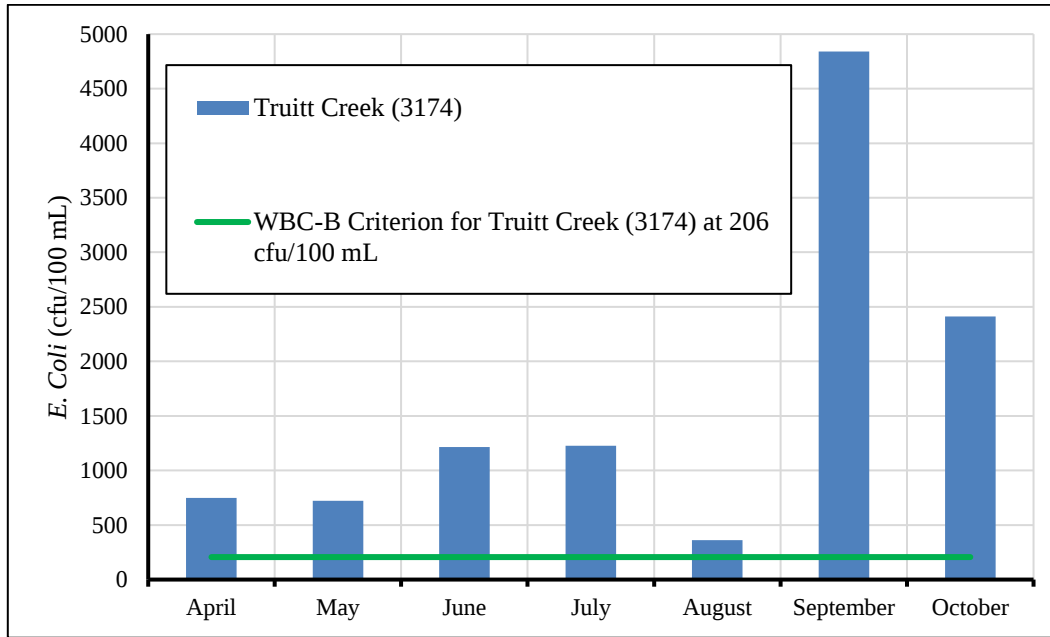


Figure 56C. Geometric means of *E. coli* samples by month from 2007, 2008, 2010-2014, and 2023 in Truitt Creek (3174)

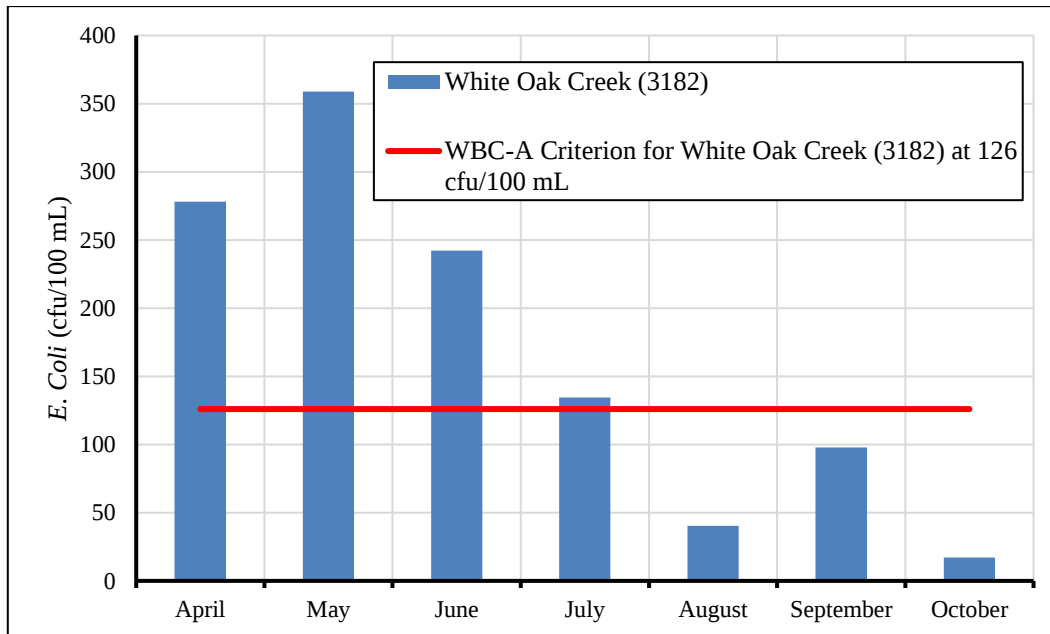


Figure 57C. Geometric means of *E. coli* samples by month from 2007, 2010, and 2011 in White Oak Creek (3182)

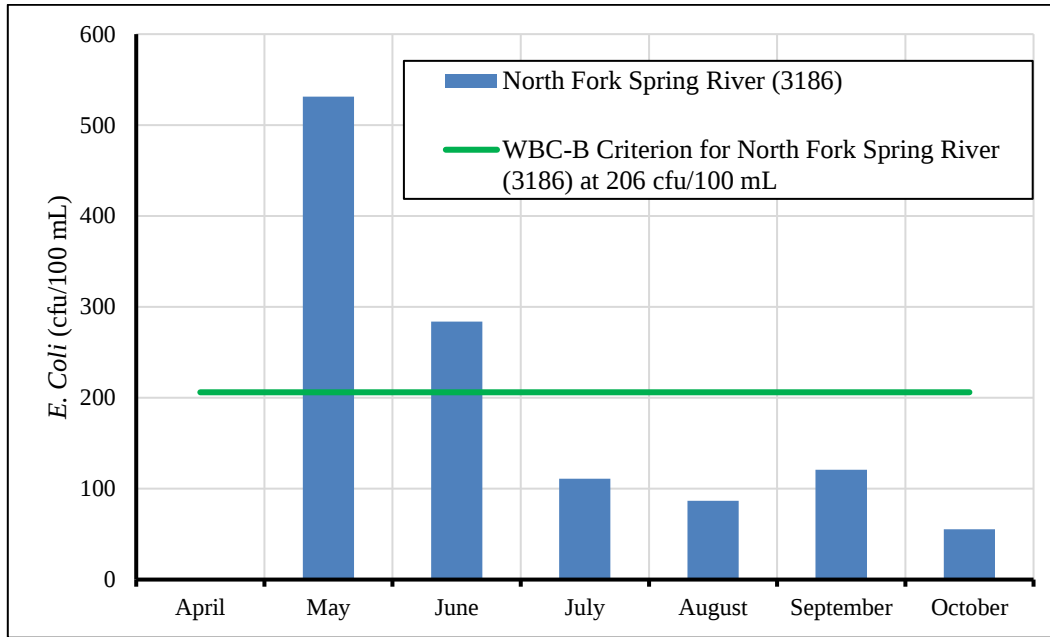


Figure 58C. Geometric means of *E. coli* samples by month from 2007, 2010, and 2012-2020 in North Fork Spring River (3186)

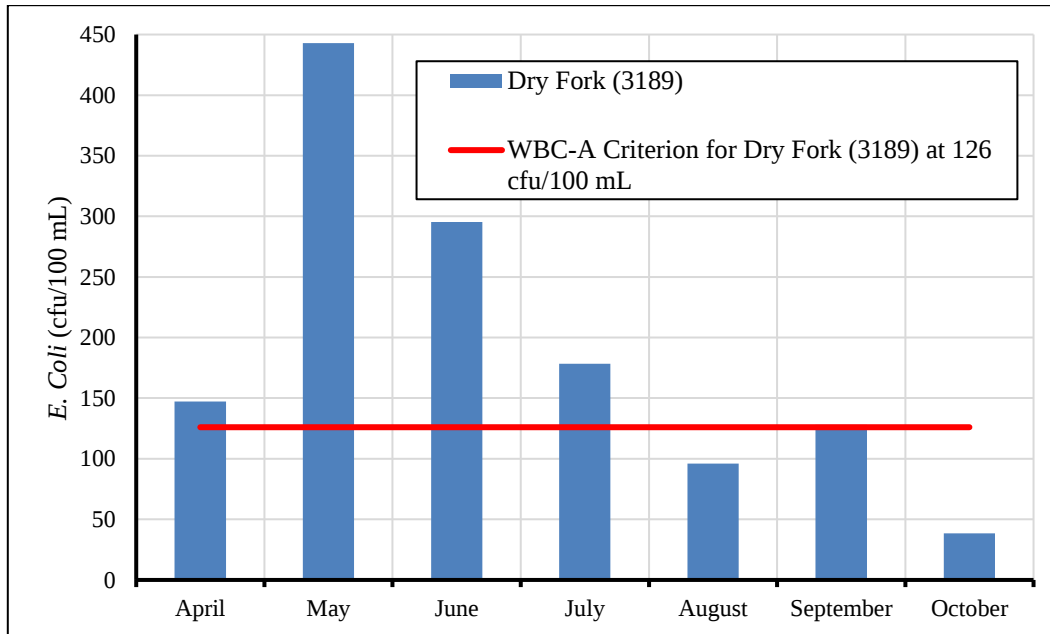


Figure 59C. Geometric means of *E. coli* samples by month from 2007 and 2010-2020 in Dry Fork (3189)

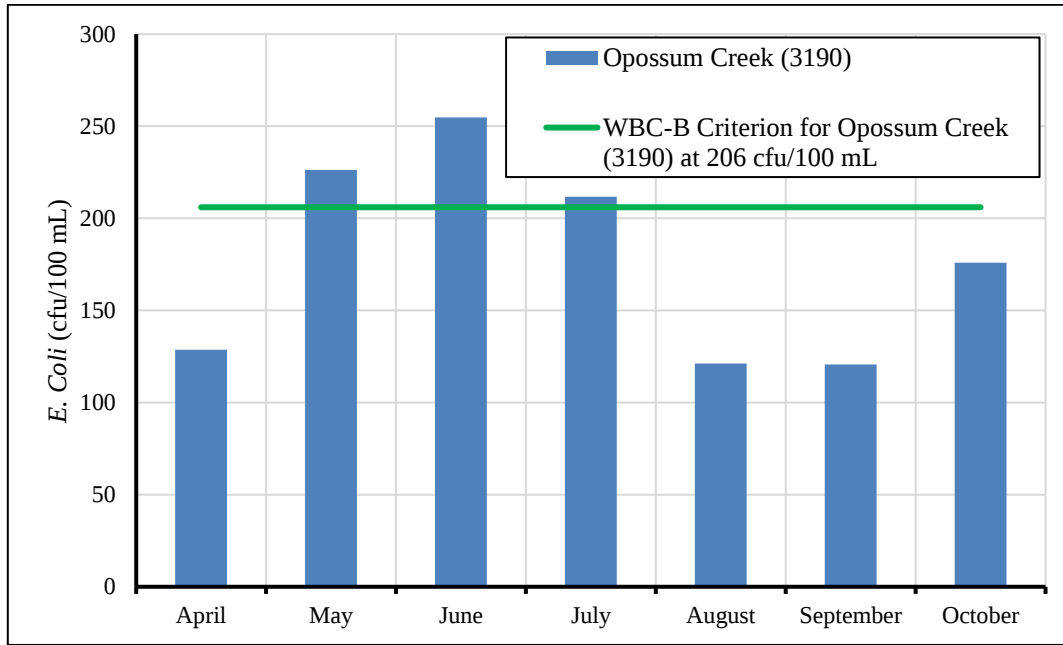


Figure 60C. Geometric means of *E. coli* samples by month from 2010, 2011, and 2014-2016 in Opossum Creek (3190)

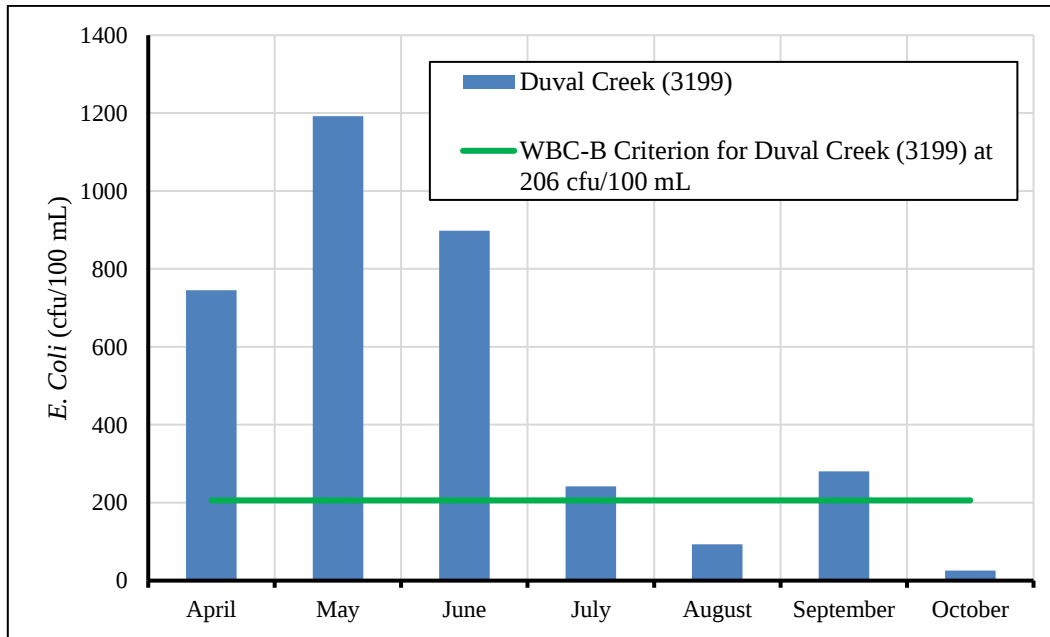


Figure 61C. Geometric means of *E. coli* samples by month from 2010 and 2011 in Duval Creek (3199)

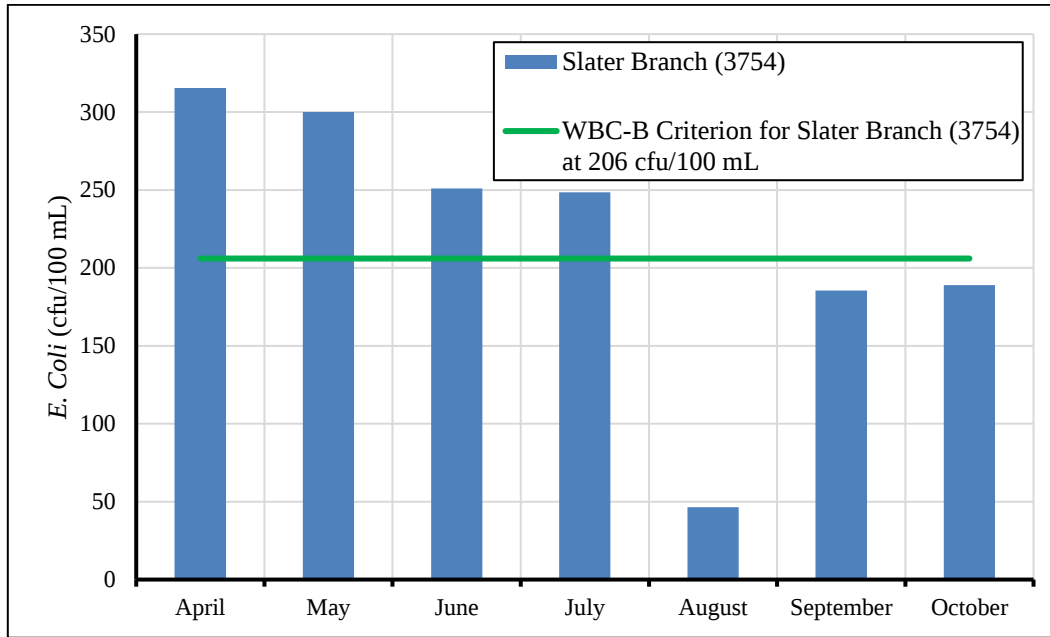


Figure 62C. Geometric means of *E. coli* samples by month from 2010 and 2011 in Slater Branch (3754)

Appendix D: Watershed Maps

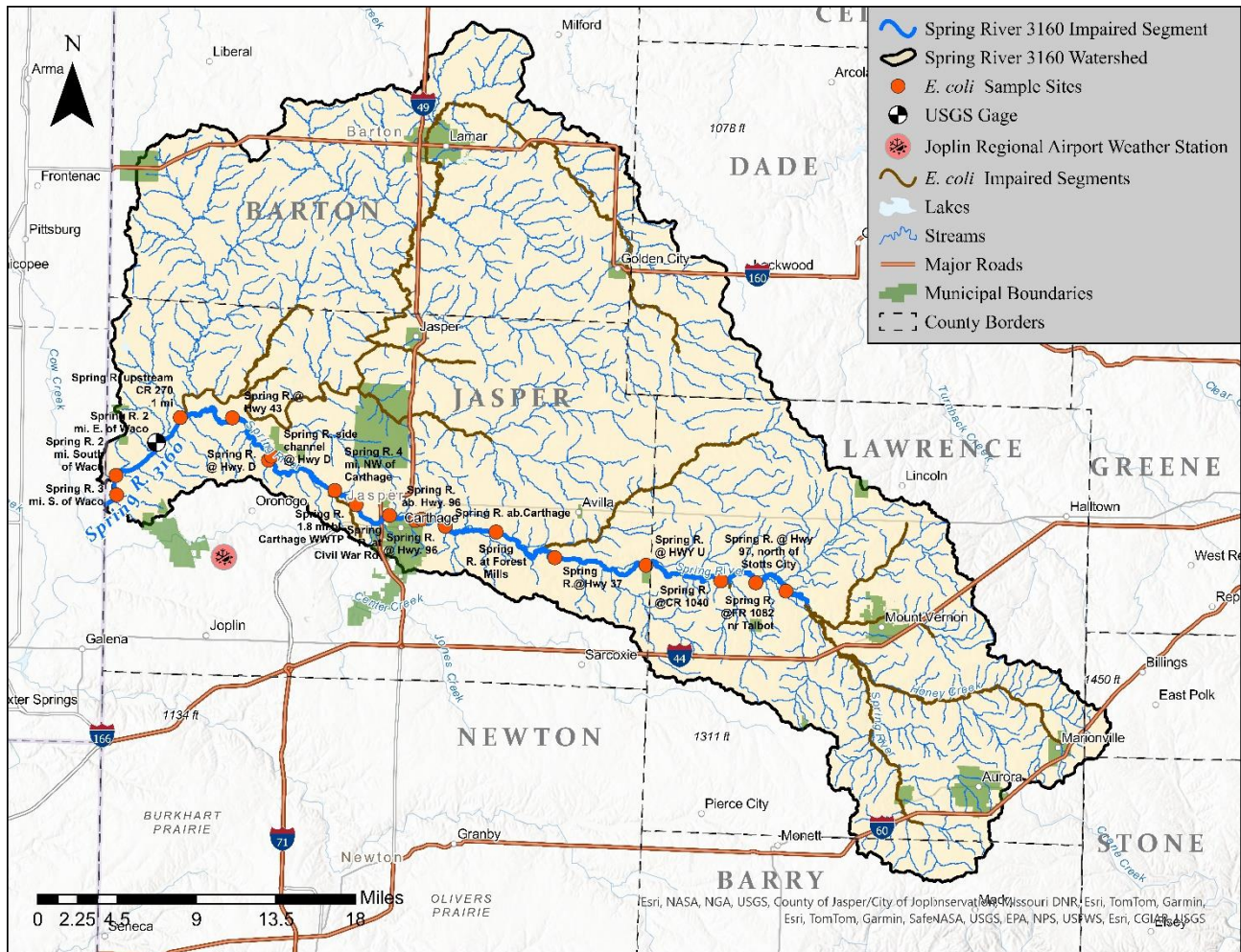


Figure 63D. Spring River (3160) Watershed Map

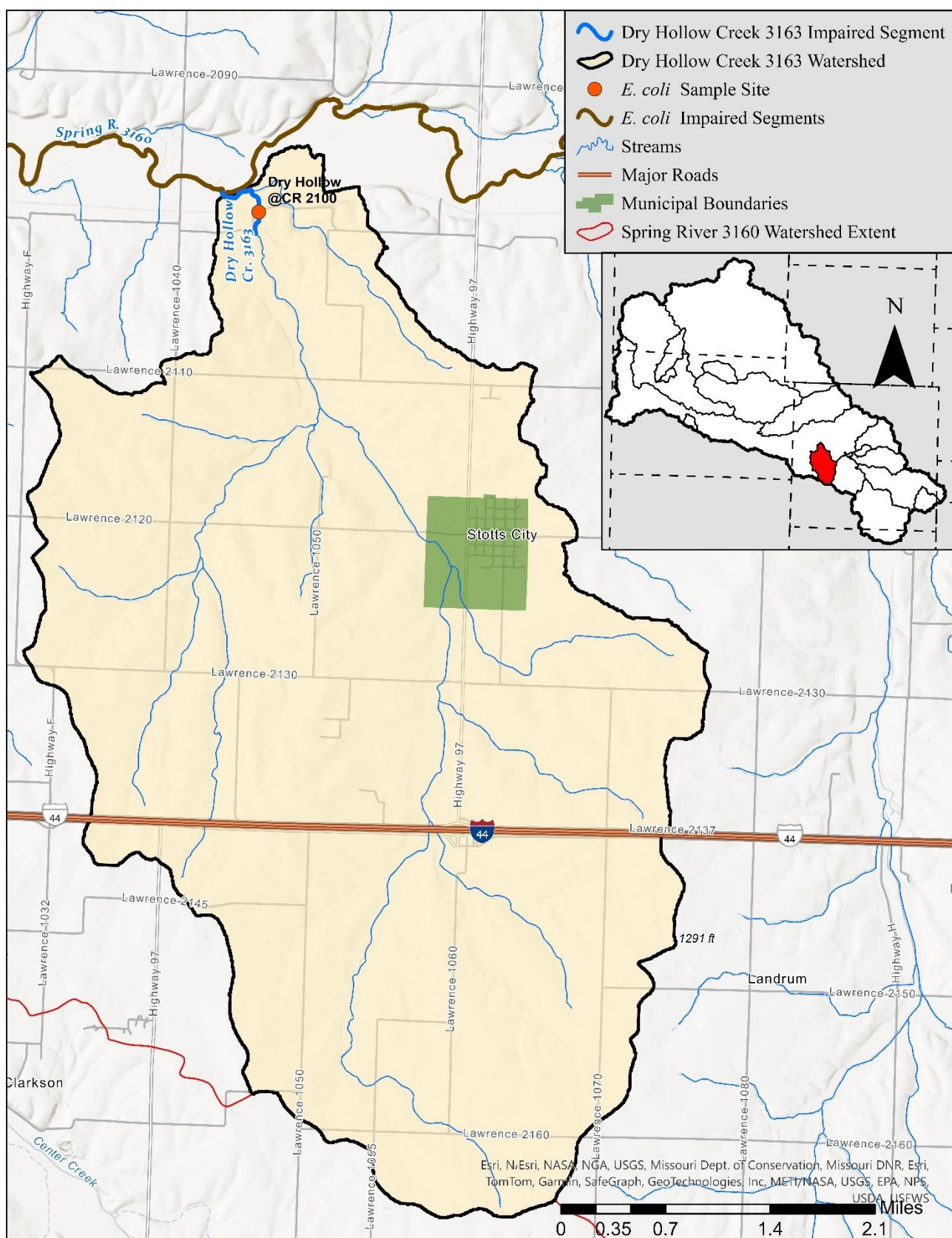


Figure 64D. Dry Hollow Creek (3163) Watershed Map

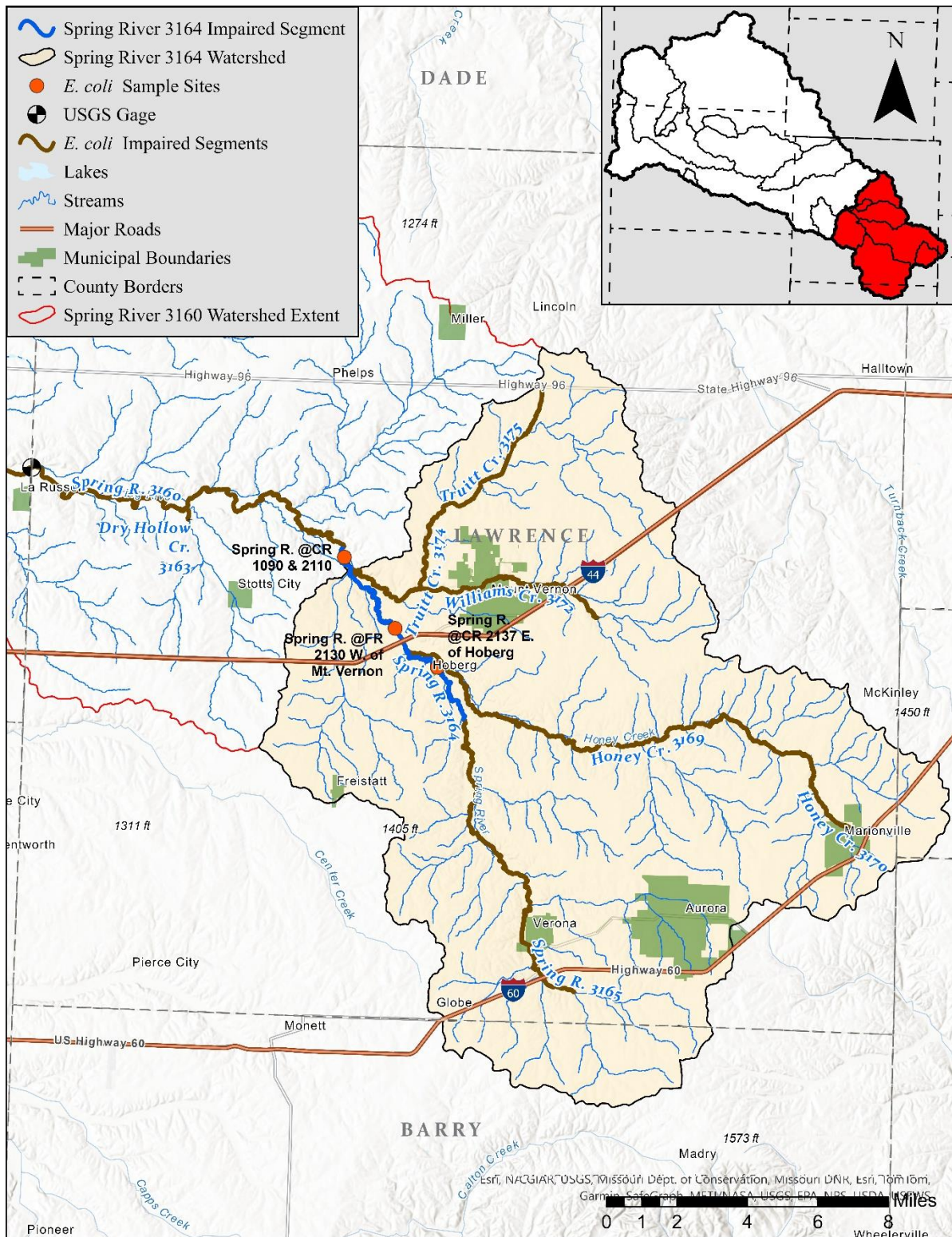


Figure 65D. Spring River (3164) Watershed Map

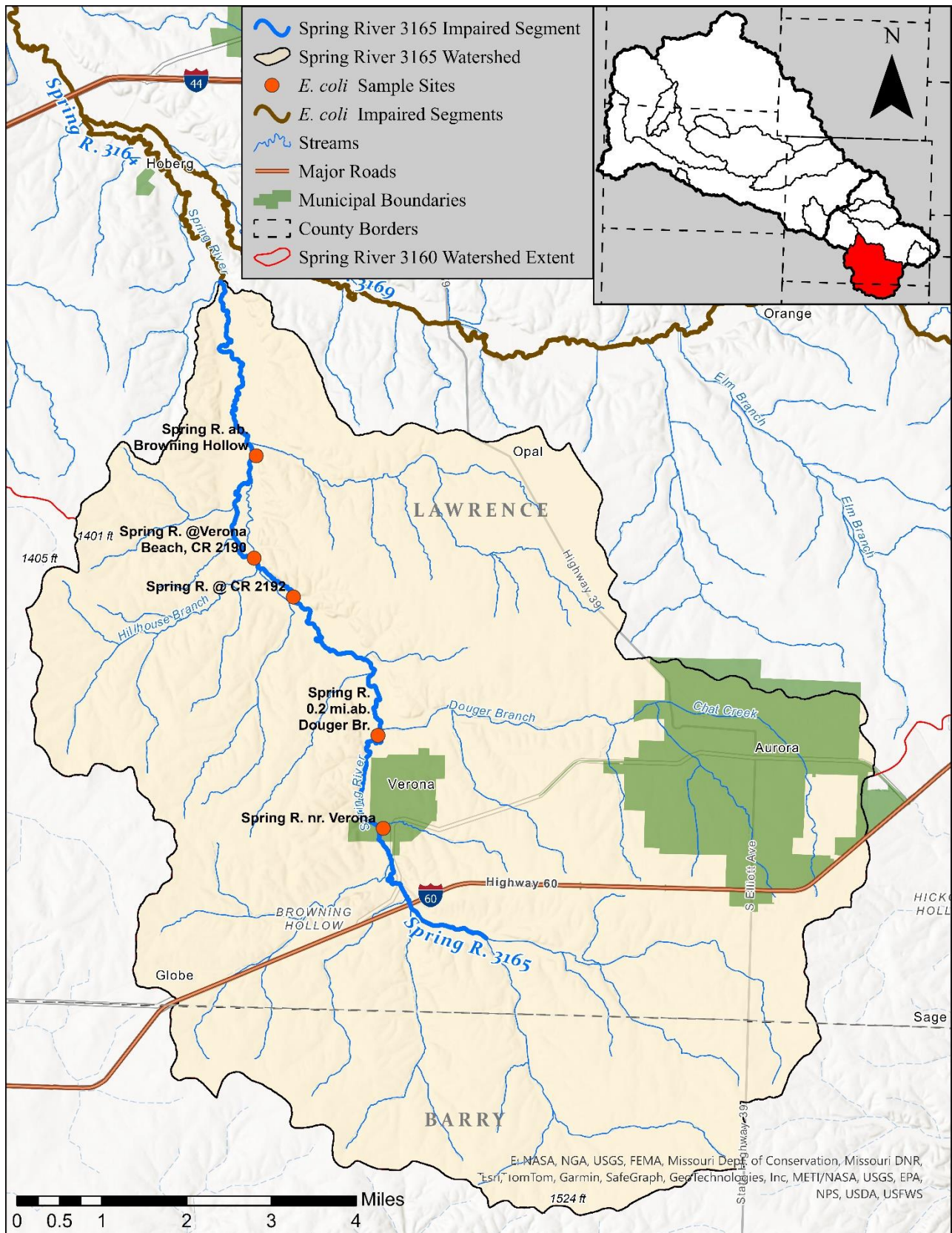


Figure 66D. Spring River (3165) Watershed Map

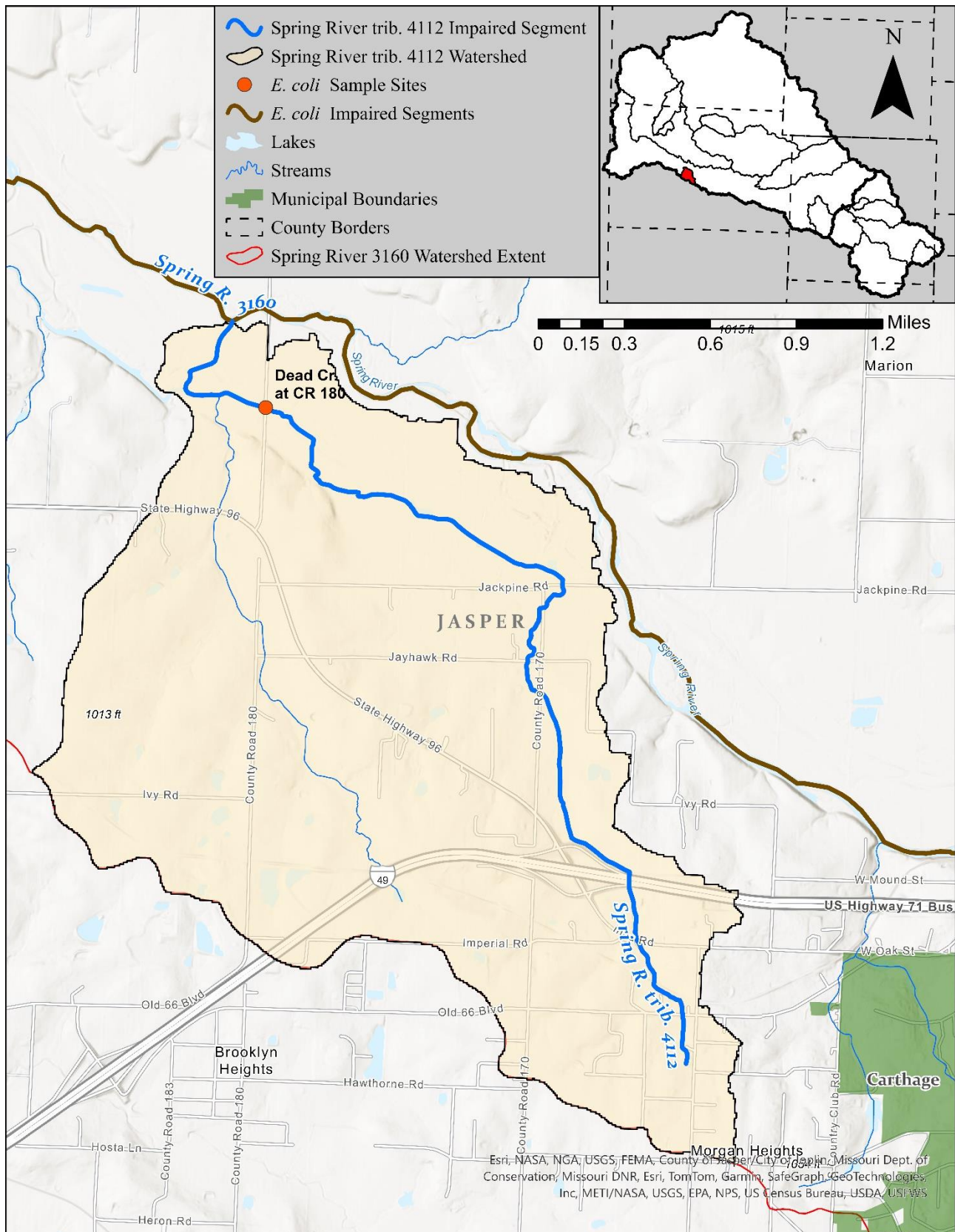


Figure 67D. Spring River tributary (4112) Watershed Map

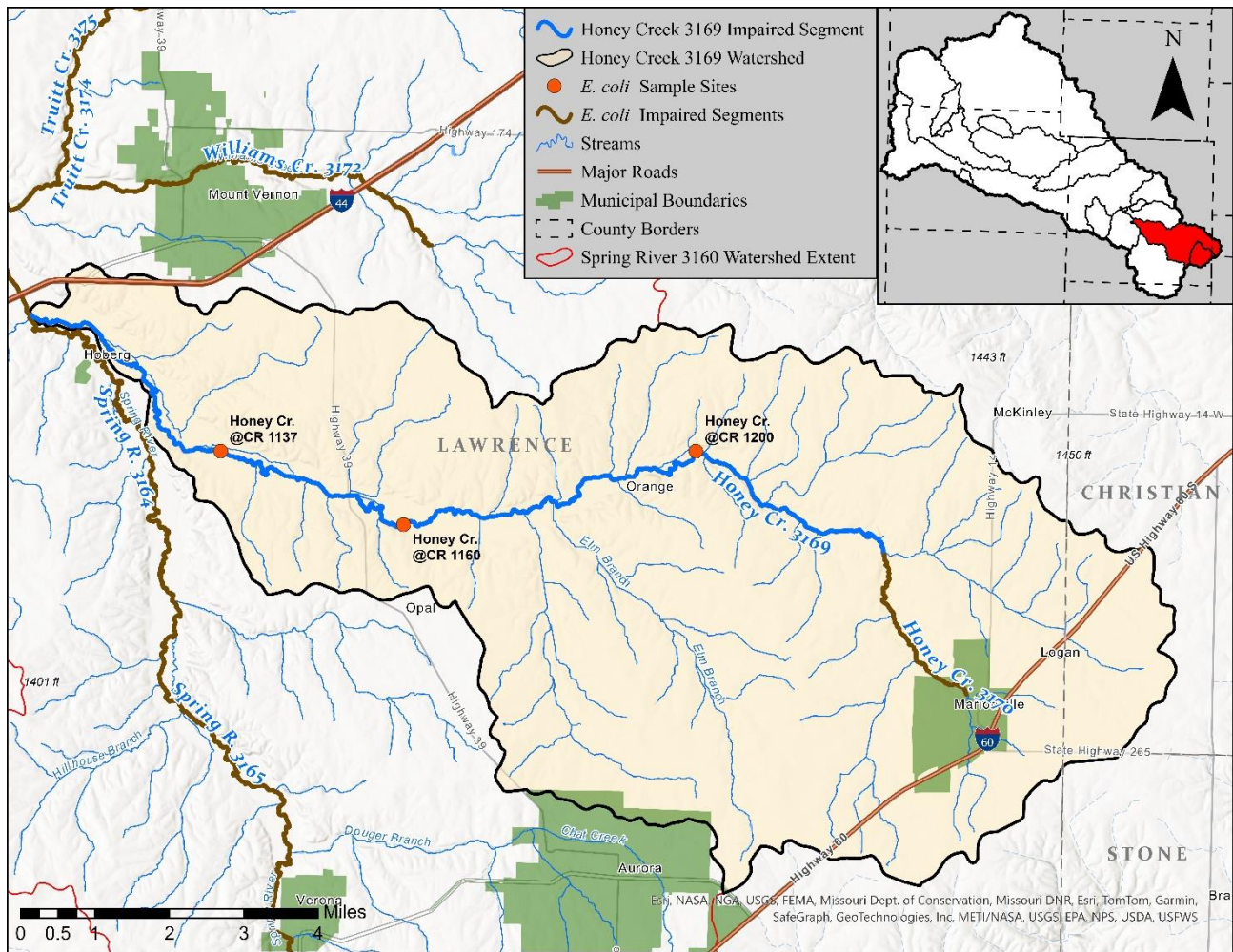


Figure 68D. Honey Creek (3169) Watershed Map

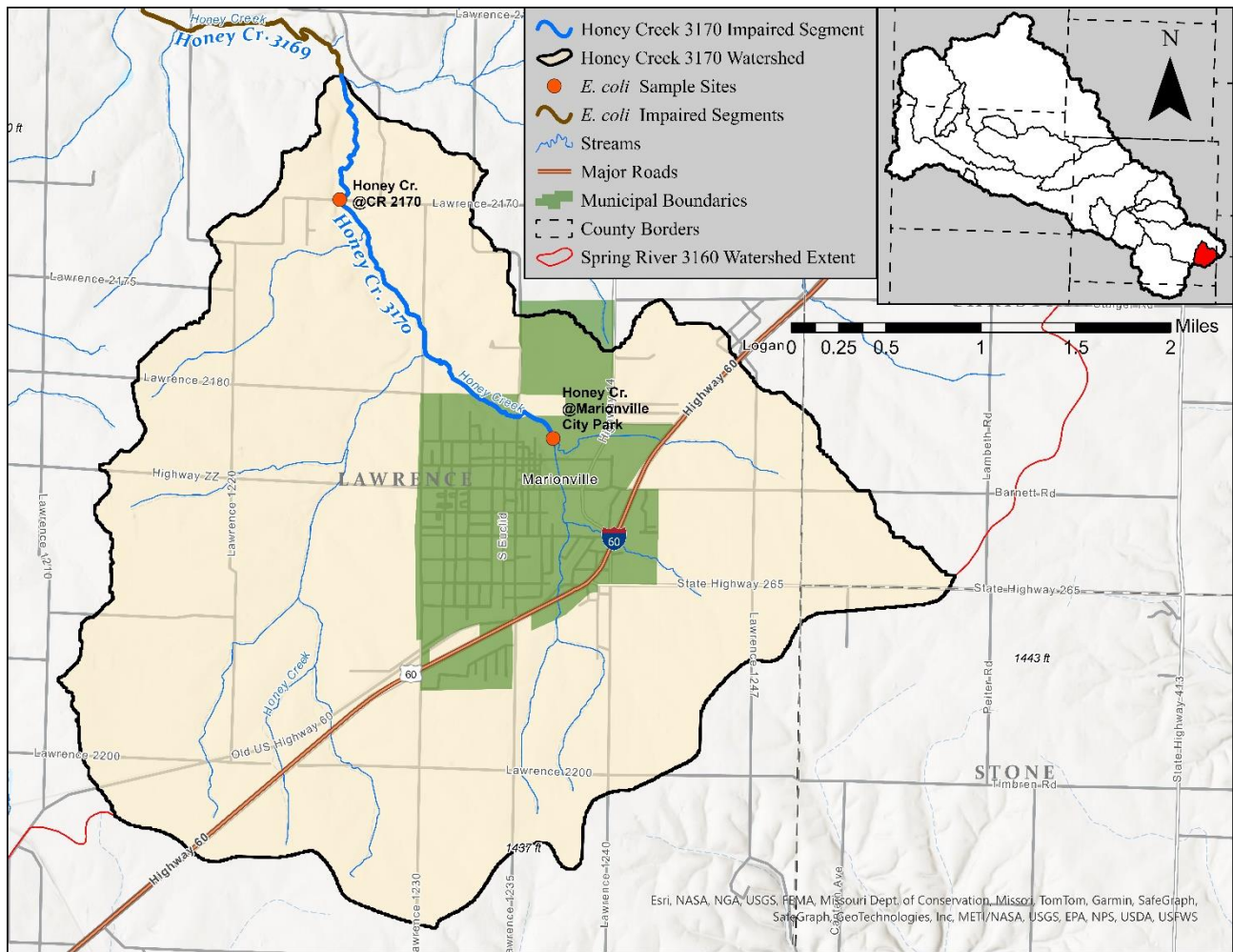


Figure 69D. Honey Creek (3170) Watershed Map

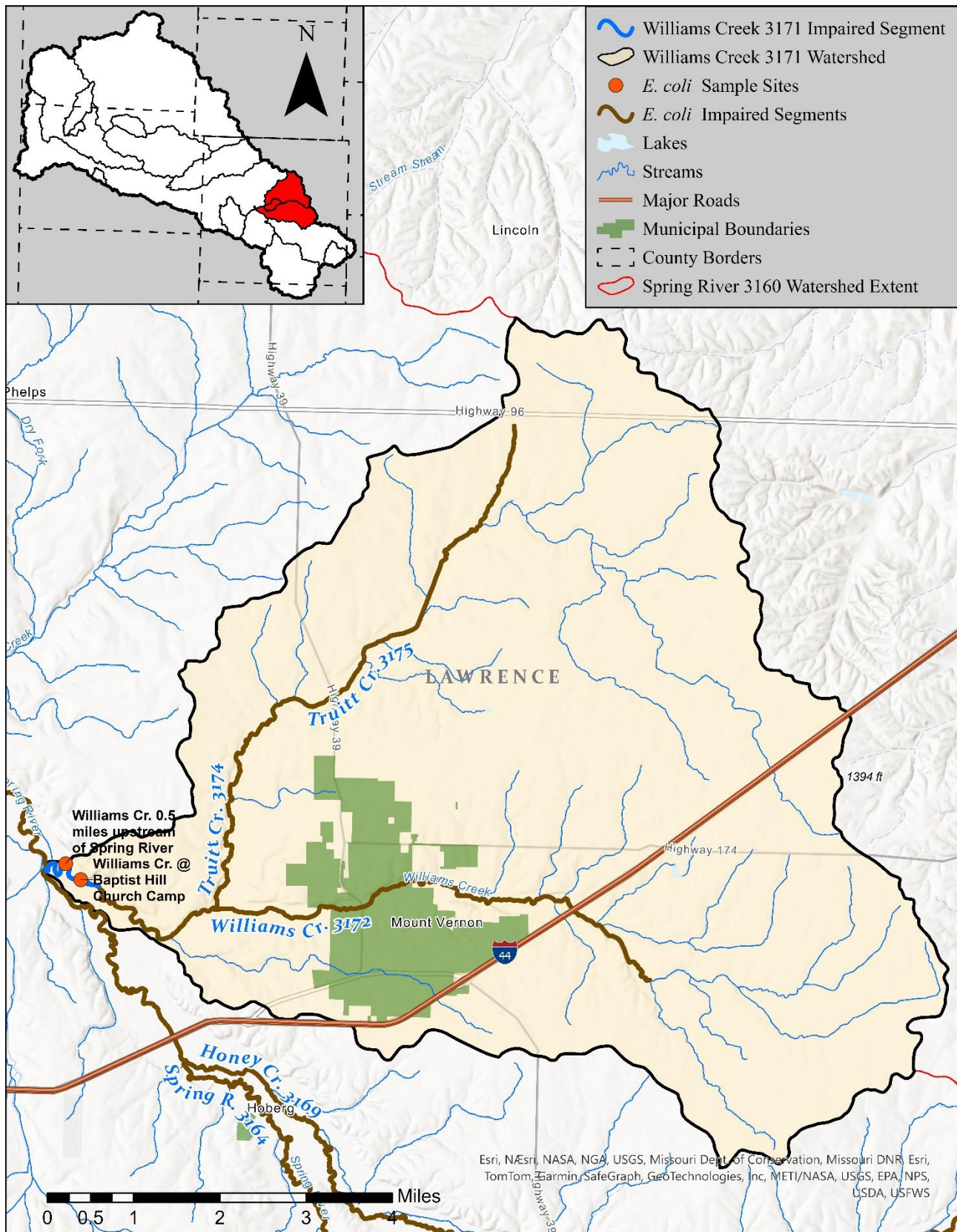


Figure 70D. Williams Creek (3171) Watershed Map

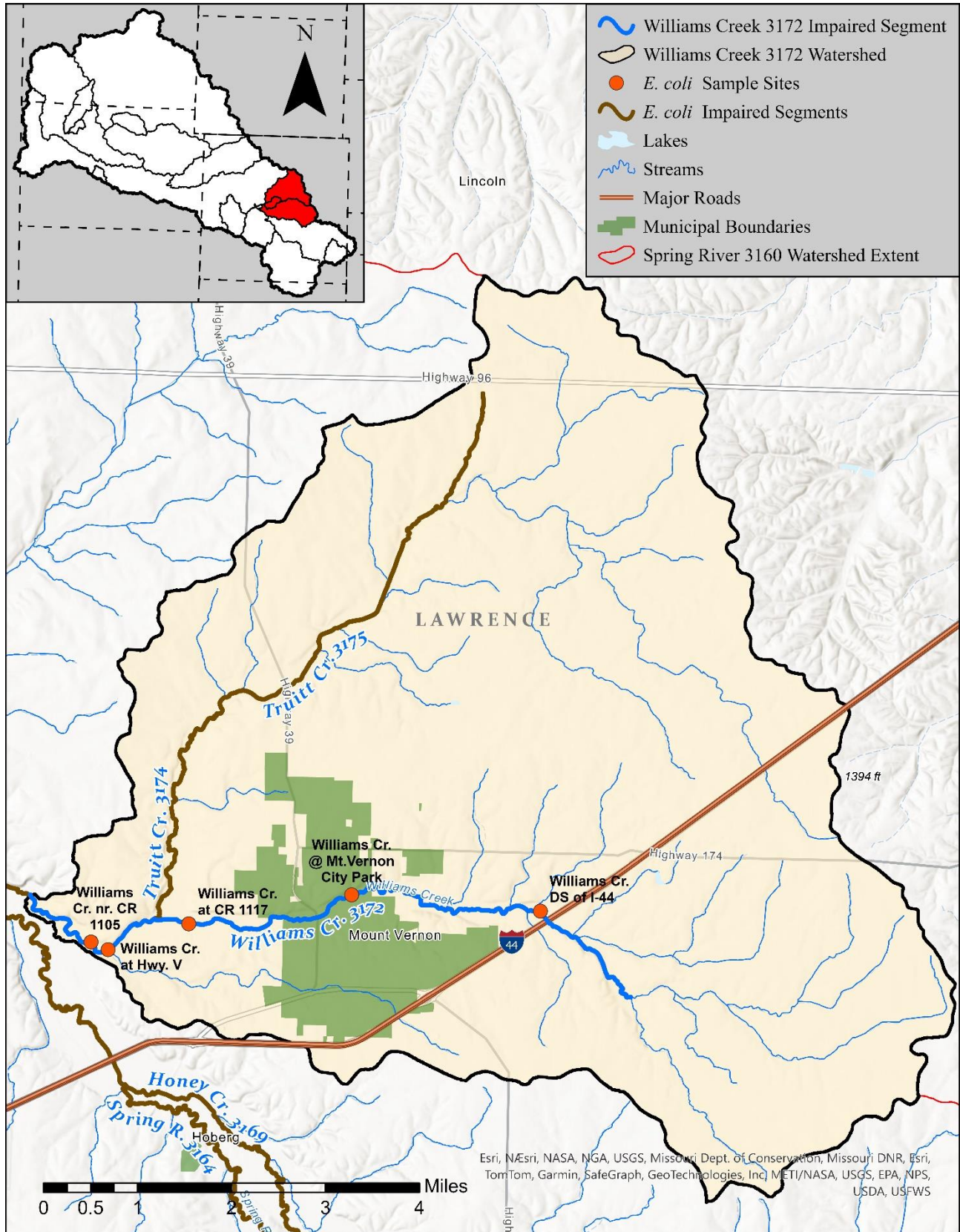


Figure 71D. Williams Creek (3172) Watershed Map



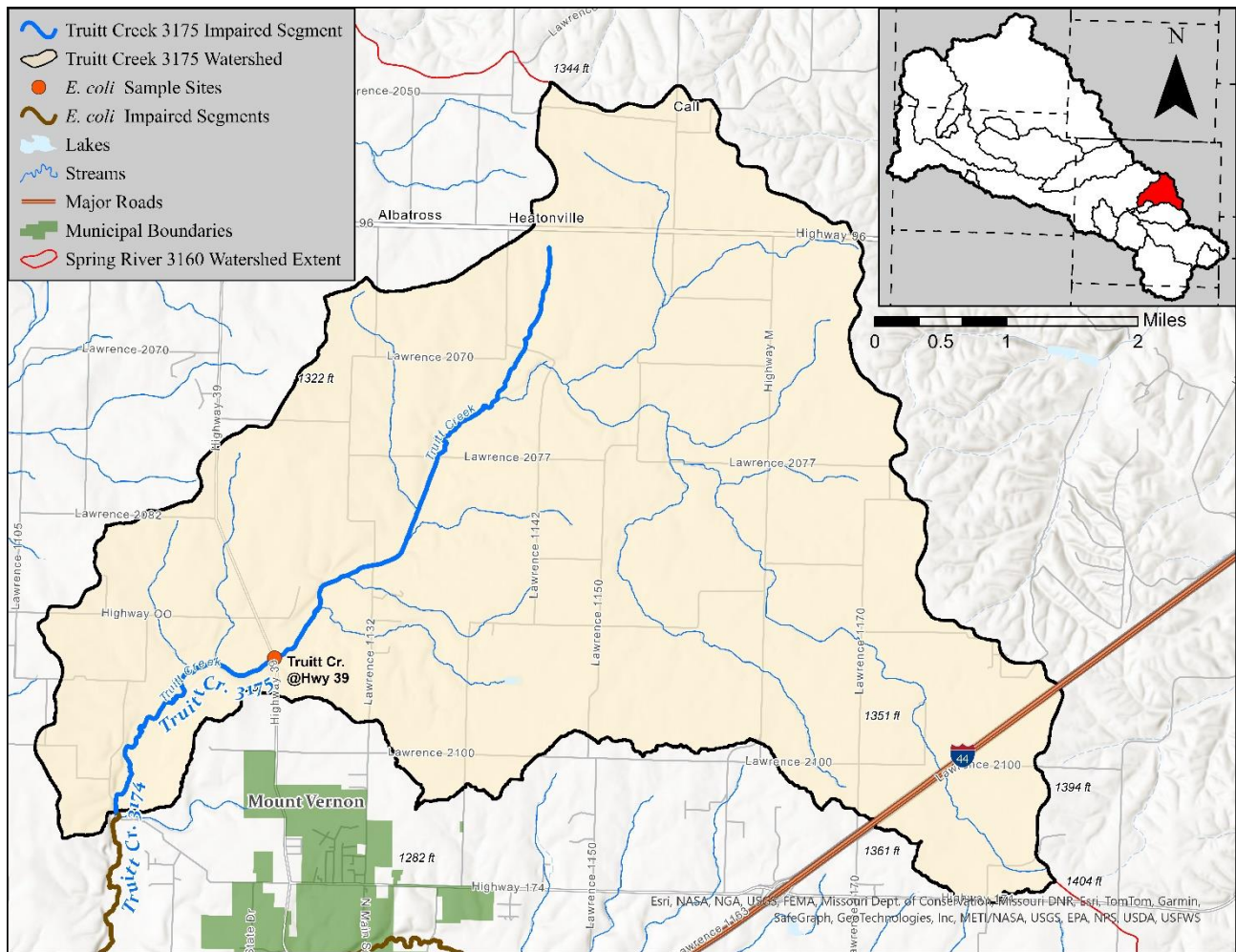


Figure 73D. Truitt Creek (3175) Watershed Map

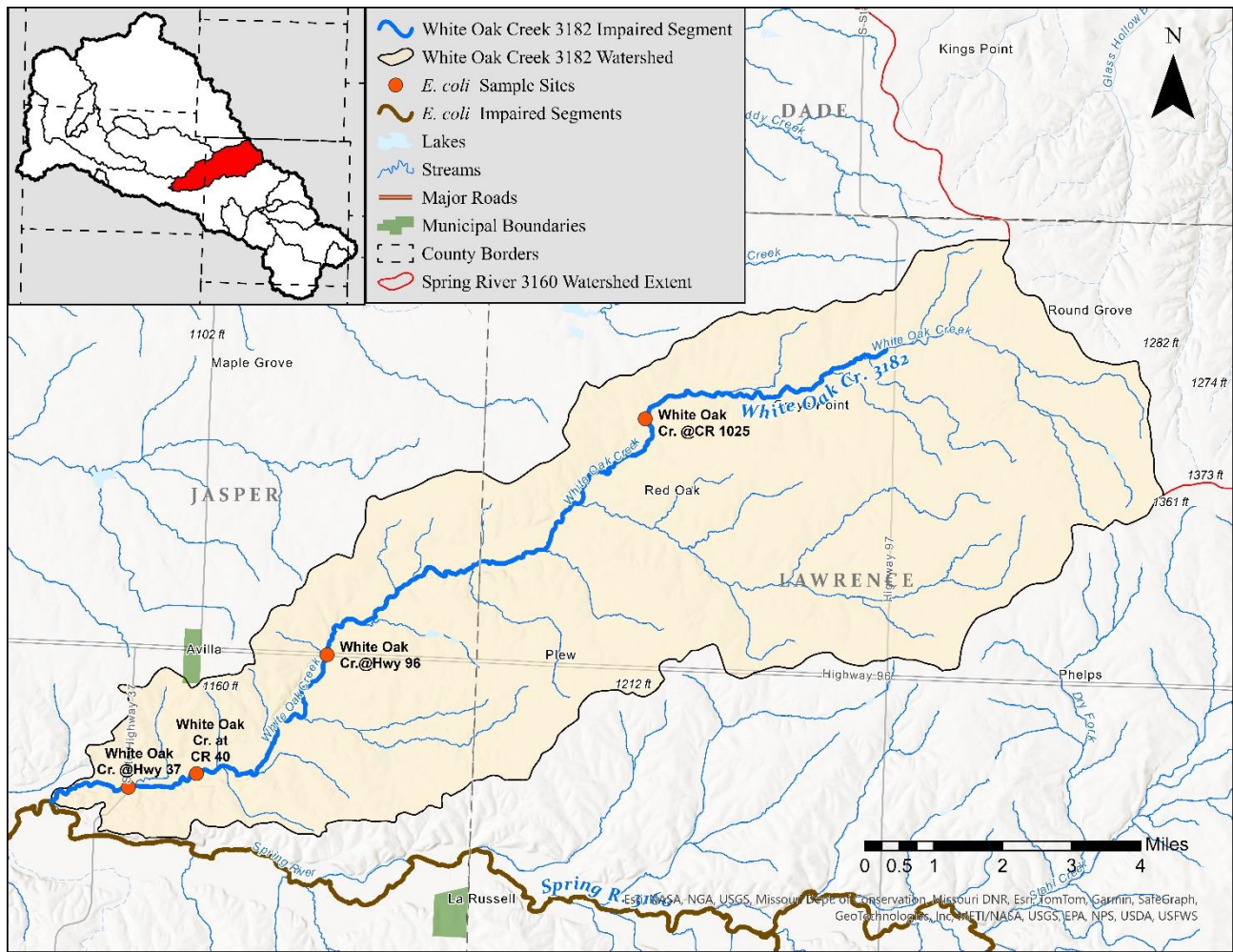
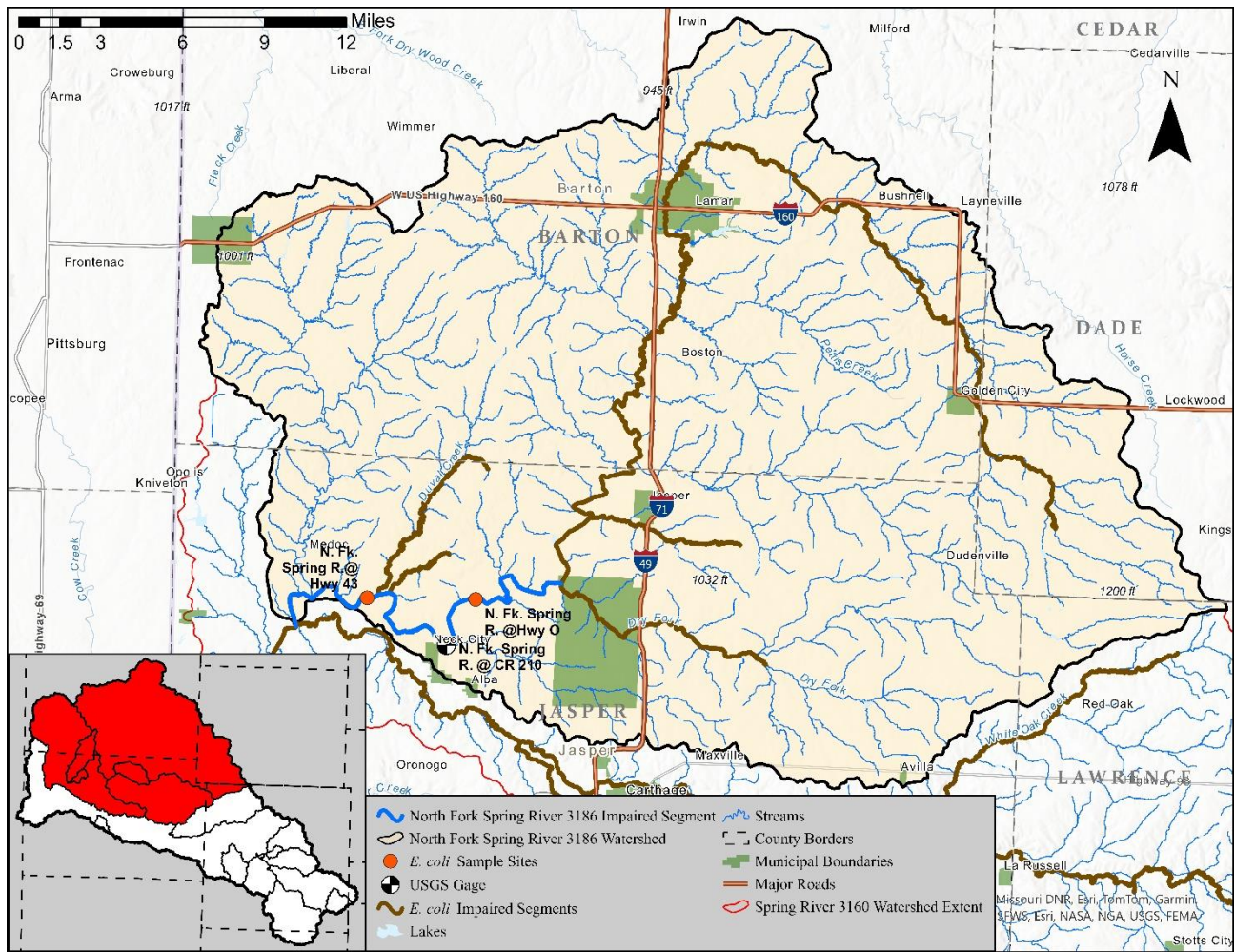


Figure 74D. White Oak Creek (3182) Watershed Map



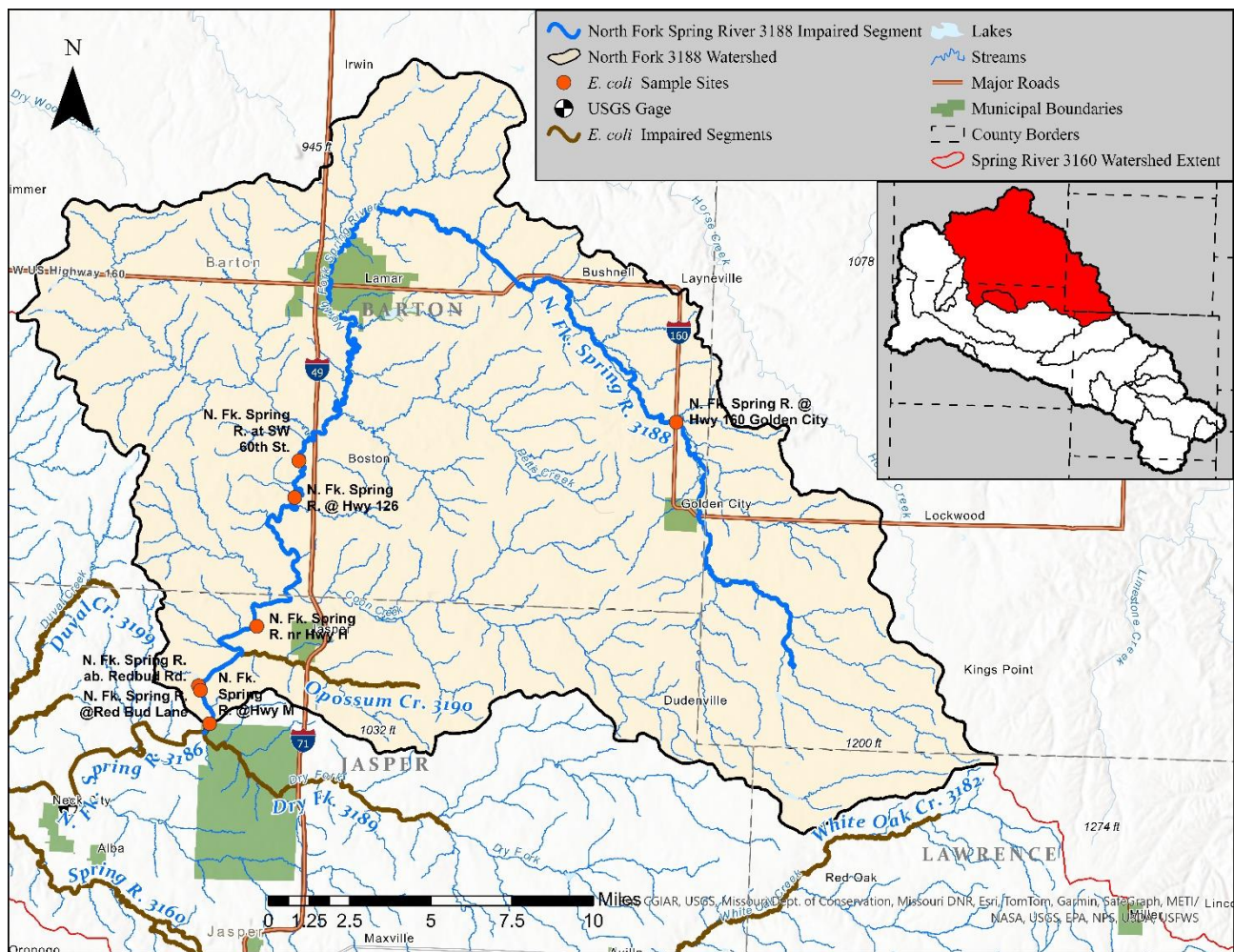


Figure 76D. North Fork Spring River (3188) Watershed Map

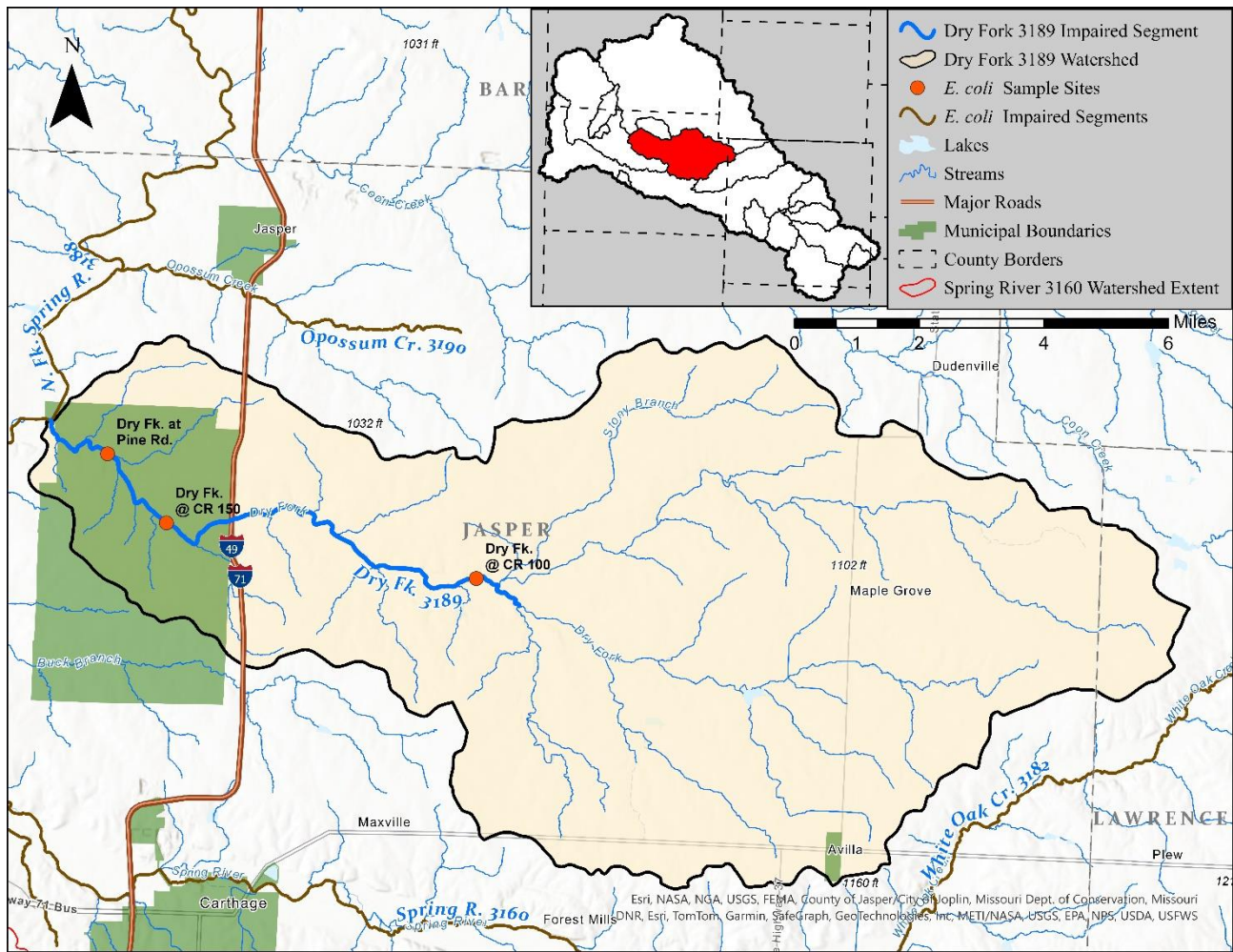


Figure 77D. Dry Fork (3189) Watershed Map

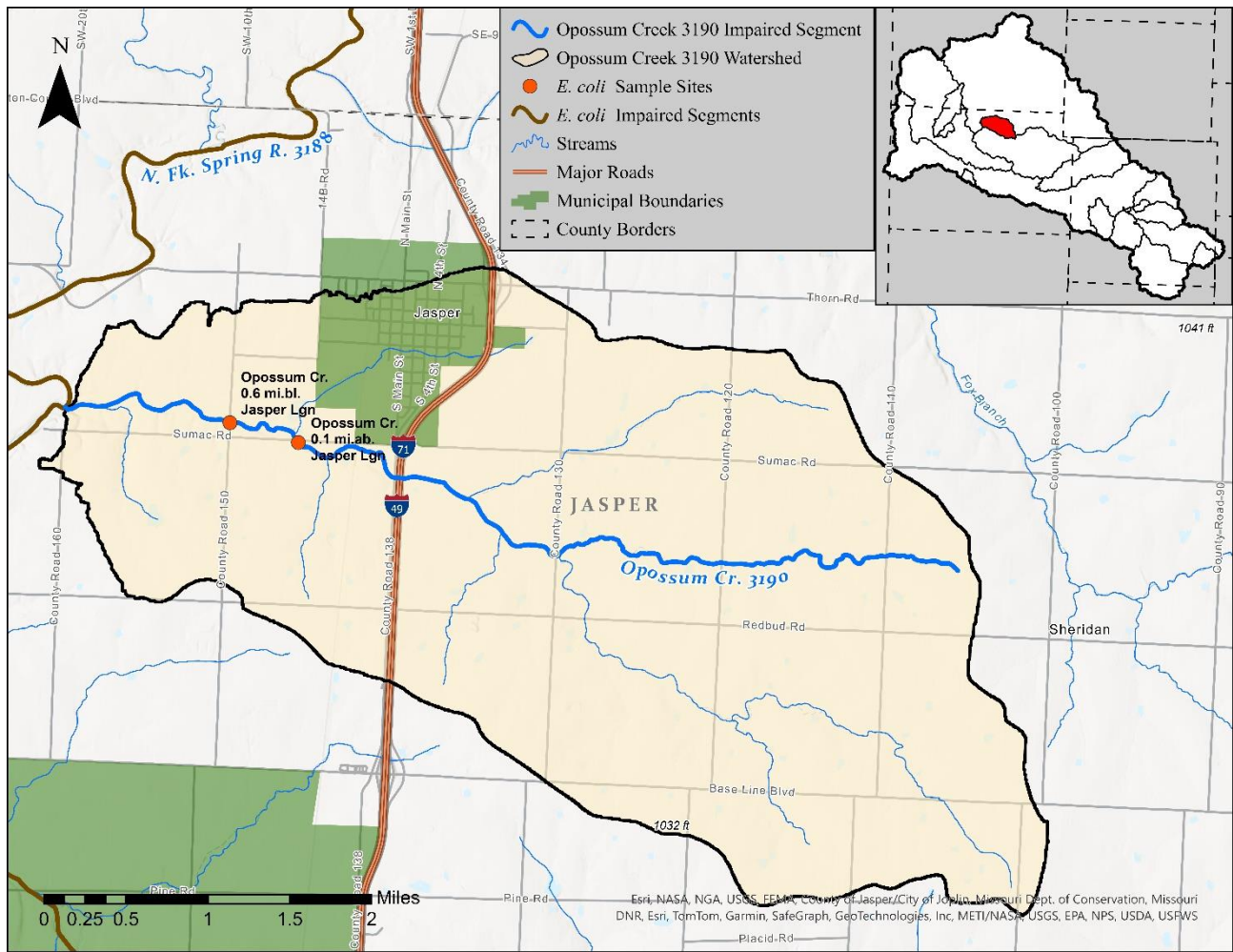


Figure 78D. Opossum Creek (3190) Watershed Map

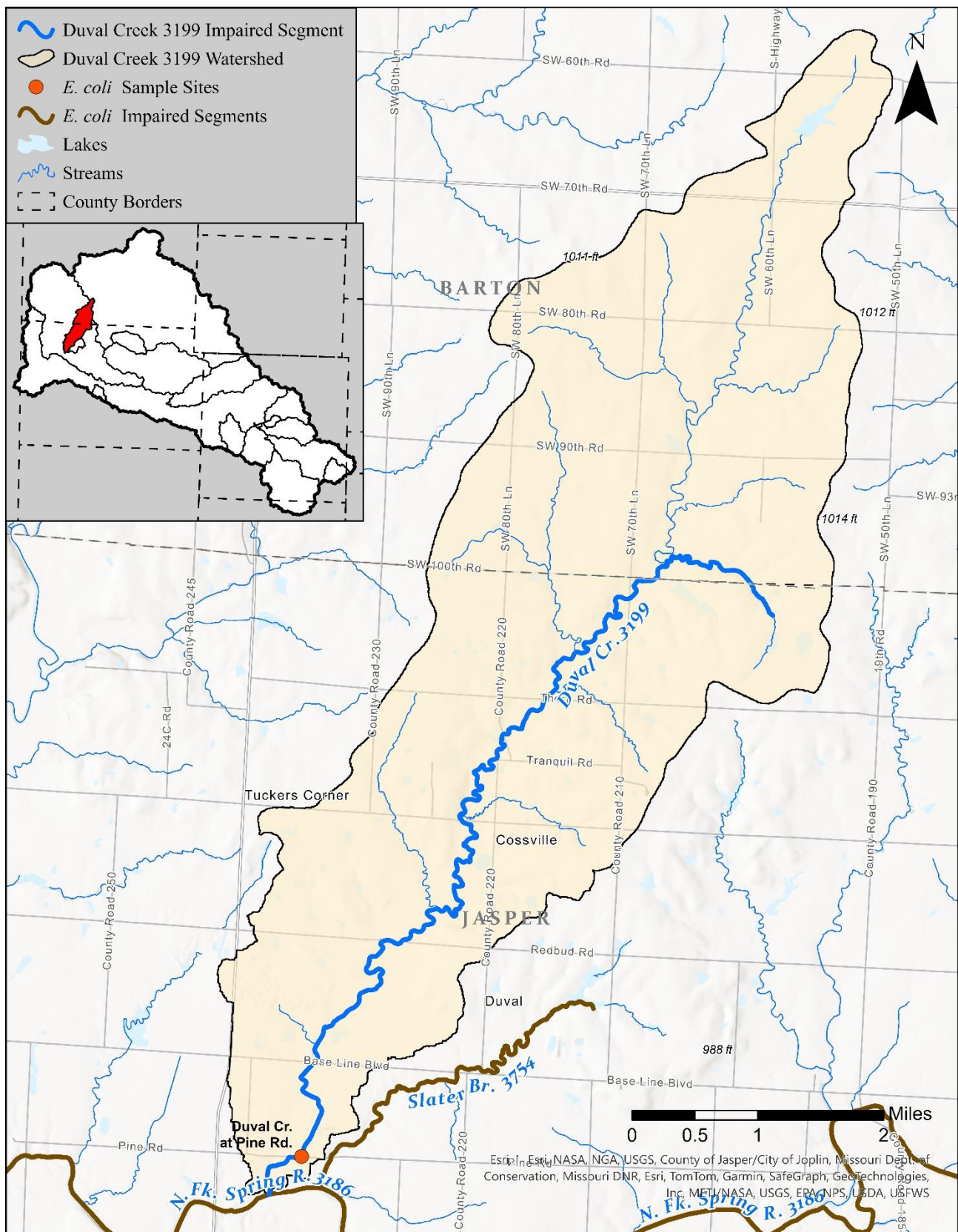


Figure 79D. Duval Creek (3199) Watershed Map

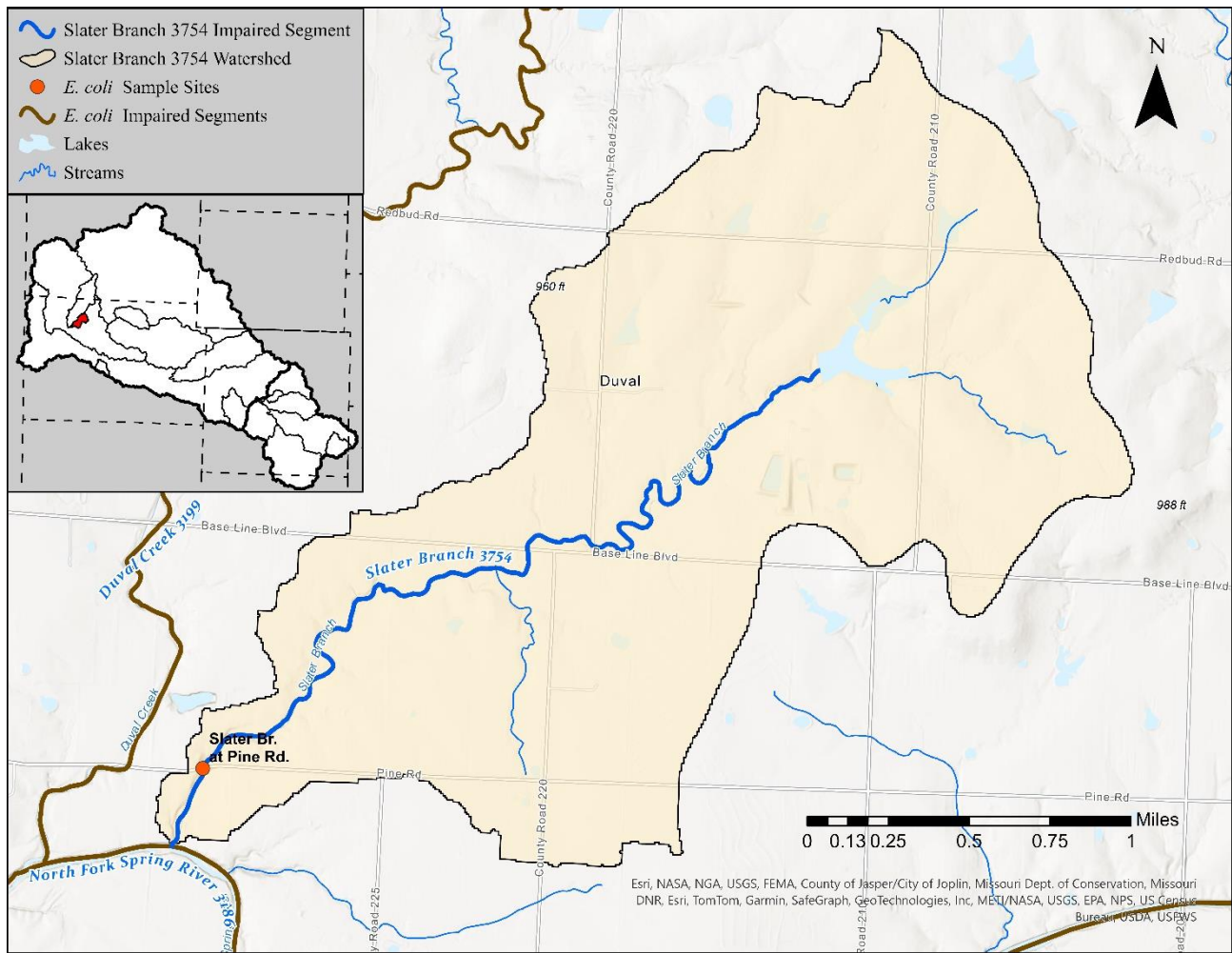


Figure 80D. Slater Branch (3754) Watershed Map

Appendix E: Existing Loads and Needed Reductions

TMDL targets are based on the applicable *E. coli* criteria for the protection of recreational uses in each stream. These targets are represented in Section 7 of the TMDL using load duration curves. Observed data are plotted on the load duration curve graphs to demonstrate the magnitude of existing loading and can be used to estimate the amount of pollutant reduction needed to meet the target and attain water quality standards. Points above the curve exceed the loading capacity and points on or below the curve are in compliance with water quality standards. The load duration curves also help to identify and differentiate between storm-driven loading and the presence of continuous loading. Storm-driven loading is expected under wet conditions when precipitation and runoff are high. Continuous loading is often evident at low flows when point source discharges have greater influence on water quality. When no point sources are present, low flow exceedances may be due to onsite wastewater treatment systems or livestock entering the stream. This could be true for the Truitt Creek (3174 and 3175) watersheds that have no point sources discharging *E. coli* but require large reductions to meet loading targets. For other watersheds, bacteria reductions are primarily needed during conditions above low flow conditions when stormwater influences are present.

BMPs that address stormwater, and agricultural runoff will address the most significant sources of pollutant loading to the streams. Additional water quality monitoring conducted during watershed planning may help determine specific areas, or “hot spots,” where significant loading is occurring and where BMPs may be the most effective. Groups wishing to develop a monitoring component to any localized watershed plan are encouraged to consult with the department’s Water Quality Monitoring and Assessment Unit, available at 573-522-4505.

***E. coli* Bacteria**

The *E. coli* TMDLs for the Spring River, and its tributaries are represented by load duration curves that quantify the loading capacities of each water body at all possible flows. Tables 39E through 56E summarize the TMDLs at selected flows and the estimated load reductions that are needed to meet the TMDL targets. The load reductions were calculated based on the geometric mean of observed *E. coli* data recorded during each selected flow regime. A geometric mean was used to remain consistent with Missouri’s *E. coli* criteria. As shown, *E. coli* concentrations do not exceed water quality criterion during all flow conditions.

For the impaired segments that overlap with losing stream segments (Dry Hollow 3163, Spring River 3164 & 3165, Honey Creek 3169, and Truitt Creek 3175) observed *E. coli* data, if available, are included from throughout the entire year. Therefore, the estimated reductions for those impaired streams are for year round protection.

Table 40E. Spring River (3160) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded 33	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	53.30	1.64E+11	1.22E+11	0.00E+00	0.00%	93
90-60	Dry Conditions	158.07	4.87E+11	3.16E+11	0.00E+00	0.00%	82
60-40	Mid Range	375.93	1.16E+12	1.13E+12	0.00E+00	0.00%	123
40-10	Moist Conditions	969.72	2.99E+12	5.85E+12	2.86E+12	49%	247
10-0	High Flow	5,084.20	1.57E+13	1.61E+14	1.46E+14	90%	1,296

Table 41E. Dry Hollow Creek (3163) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	1.66	5.12E+09	1.70E+09	0.00E+00	0.00%	42
90-60	Dry Conditions	4.76	1.47E+10	1.19E+10	0.00E+00	0.00%	102
60-40	Mid Range	9.70	2.99E+10	3.59E+10	6.02E+09	16.75%	151
40-10	Moist Conditions	21.68	6.68E+10	2.86E+11	2.19E+11	76.63%	539
10-0	High Flow	68.61	2.12E+11	6.07E+12	5.86E+12	96.52%	3,617

³³ The percent of time flow is equaled or exceeded is a statistical measure used to divide the load duration curve into flow ranges that are indicative of low flow, dry conditions, mid range, moist conditions, and high flows. For example, a 10 percent value indicates a high flow that only occurs or is exceeded 10 percent of the time.

Table 42E. Spring River (3164) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	34.55	1.07E+11	1.07E+11	4.90E+08	0.46%	127
90-60	Dry Conditions	67.14	2.07E+11	3.20E+11	1.13E+11	35.30%	195
60-40	Mid Range	125.27	3.86E+11	1.24E+12	8.49E+11	68.74%	403
40-10	Moist Conditions	273.23	8.42E+11	5.49E+12	4.65E+12	84.67%	822
10-0	High Flow	753.02	2.32E+12	7.95E+13	7.72E+13	97.08%	4,317

Table 43E. Spring River (3165) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	2.65	8.16E+09	7.74E+09	0.00E+00	0.00%	119
90-60	Dry Conditions	13.72	4.23E+10	5.29E+10	1.06E+10	20.01%	158
60-40	Mid Range	31.51	9.71E+10	1.56E+11	5.84E+10	37.55%	202
40-10	Moist Conditions	84.40	2.60E+11	7.66E+11	5.05E+11	66.01%	371
10-0	High Flow	366.41	1.13E+12	5.28E+13	5.16E+13	97.86%	5,886

Table 44E. Spring River tributary (4112) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	0.32	9.80E+08	1.13E+09	1.46E+08	12.96%	145
90-60	Dry Conditions	0.93	2.86E+09	4.74E+09	1.89E+09	39.78%	209
60-40	Mid Range	1.89	5.84E+09	4.26E+09	0.00E+00	0.00%	92
40-10	Moist Conditions	4.24	1.31E+10	1.45E+10	1.44E+09	9.93%	140
10-0	High Flow	13.44	4.14E+10	4.69E+11	4.27E+11	91.16%	1,425

Table 45E. Honey Creek (3169) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	2.68	8.26E+09	1.38E+10	5.57E+09	40.29%	211
90-60	Dry Conditions	13.88	4.28E+10	1.70E+11	1.27E+11	74.81%	500
60-40	Mid Range	31.87	9.83E+10	5.14E+11	4.15E+11	80.87%	659
40-10	Moist Conditions	85.37	2.63E+11	1.06E+12	7.92E+11	75.07%	505
10-0	High Flow	370.63	1.14E+12	6.13E+13	6.01E+13	98.14%	6,757

Table 46E. Honey Creek (3170) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	2.38	7.33E+09	4.55E+10	3.81E+10	83.88%	782
90-60	Dry Conditions	3.50	1.08E+10	7.12E+10	6.05E+10	84.85%	832
60-40	Mid Range	4.92	1.52E+10	1.30E+11	1.15E+11	88.36%	1,083
40-10	Moist Conditions	8.23	2.54E+10	8.67E+10	6.14E+10	70.76%	431
10-0	High Flow	19.21	5.92E+10	No Data	No Data	No Data	No Data

Table 47E. Williams Creek (3171) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	2.16	6.66E+09	No Data	No Data	No Data	No Data
90-60	Dry Conditions	11.19	3.45E+10	1.75E+10	0.00E+00	0.00%	64
60-40	Mid Range	25.70	7.92E+10	No Data	No Data	No Data	No Data
40-10	Moist Conditions	68.84	2.12E+11	4.88E+11	2.76E+11	56.51%	290
10-0	High Flow	298.86	9.21E+11	2.87E+12	1.95E+12	67.94%	393

Table 48E. Williams Creek (3172) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	2.14	6.59E+09	4.95E+09	0.00E+00	0.00%	95
90-60	Dry Conditions	11.08	3.42E+10	7.77E+10	4.35E+10	56.01%	286
60-40	Mid Range	25.45	7.84E+10	6.25E+11	5.47E+11	87.46%	1,005
40-10	Moist Conditions	68.16	2.10E+11	3.39E+12	3.18E+12	93.79%	2,030
10-0	High Flow	295.92	9.12E+11	1.57E+13	1.48E+13	94.20%	2,173

Table 49E. Truitt Creek (3174) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	2.35	7.24E+09	8.30E+09	1.06E+09	12.75%	144
90-60	Dry Conditions	6.84	2.11E+10	2.16E+11	1.95E+11	90.23%	1,290
60-40	Mid Range	13.98	4.31E+10	3.90E+11	3.47E+11	88.94%	1,140
40-10	Moist Conditions	31.32	9.66E+10	1.15E+12	1.06E+12	91.63%	1,505
10-0	High Flow	99.26	3.06E+11	No Data	No Data	No Data	No Data

Table 50E. Truitt Creek (3175) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	2.08	6.40E+09	1.80E+11	1.73E+11	96.43%	3,533
90-60	Dry Conditions	6.05	1.87E+10	3.10E+11	2.91E+11	93.98%	2,094
60-40	Mid Range	12.37	3.81E+10	4.90E+11	4.52E+11	92.21%	1,618
40-10	Moist Conditions	27.72	8.54E+10	1.35E+12	1.27E+12	93.68%	1,993
10-0	High Flow	87.83	2.71E+11	4.58E+12	4.31E+12	94.09%	2,132

Table 51E. White Oak Creek (3182) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	2.51	7.73E+09	No Data	No Data	No Data	No Data
90-60	Dry Conditions	12.99	4.00E+10	1.30E+10	0.00E+00	0.00%	41
60-40	Mid Range	29.82	9.19E+10	1.10E+11	1.77E+10	16.13%	150
40-10	Moist Conditions	79.86	2.46E+11	9.56E+11	7.10E+11	74.25%	489
10-0	High Flow	346.73	1.07E+12	1.42E+13	1.31E+13	92.45%	1,669

Table 52E. North Fork Spring River (3186) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	3.48	1.07E+10	1.03E+09	0.00E+00	0.00%	12
90-60	Dry Conditions	27.87	8.59E+10	6.18E+10	0.00E+00	0.00%	91
60-40	Mid Range	97.33	3.00E+11	4.10E+11	1.10E+11	26.85%	172
40-10	Moist Conditions	339.75	1.05E+12	4.52E+12	3.48E+12	76.85%	544
10-0	High Flow	3,386.40	1.04E+13	7.21E+13	6.17E+13	85.52%	870

Table 53E. North Fork Spring River (3188) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	1.99	6.14E+09	2.30E+09	0.00E+00	0.00%	47.2
90-60	Dry Conditions	16.23	5.00E+10	5.00E+10	0.00E+00	0.00%	125.9
60-40	Mid Range	56.79	1.75E+11	2.74E+11	9.88E+10	36.08%	197.1
40-10	Moist Conditions	198.32	6.11E+11	2.41E+12	1.80E+12	74.65%	497.1
10-0	High Flow	1,977.06	6.09E+12	6.87E+13	6.26E+13	91.12%	1,419.3

Table 54E. Dry Fork (3189) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	4.43	1.37E+10	4.16E+09	0.00E+00	0.00%	38
90-60	Dry Conditions	15.12	4.66E+10	4.32E+10	0.00E+00	0.00%	117
60-40	Mid Range	38.38	1.18E+11	2.09E+11	9.05E+10	43.34%	222
40-10	Moist Conditions	96.28	2.97E+11	7.41E+11	4.44E+11	59.95%	315
10-0	High Flow	385.62	1.19E+12	7.89E+12	6.71E+12	84.94%	837

Table 55E. Opossum Creek (3190) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	1.42	4.39E+09	1.68E+09	0.00E+00	0.00%	48
90-60	Dry Conditions	3.74	1.15E+10	1.15E+10	0.00E+00	0.00%	126
60-40	Mid Range	7.44	2.29E+10	2.21E+10	0.00E+00	0.00%	121
40-10	Moist Conditions	16.40	5.06E+10	1.49E+11	9.82E+10	66.01%	371
10-0	High Flow	51.52	1.59E+11	5.34E+11	3.75E+11	70.27%	424

Table 56E. Duval Creek (3199) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	1.61	4.97E+09	No Data	No Data	No Data	No Data
90-60	Dry Conditions	4.70	1.45E+10	9.10E+09	0.00E+00	0.00%	79
60-40	Mid Range	9.61	2.96E+10	9.07E+10	6.11E+10	67.36%	386
40-10	Moist Conditions	21.52	6.63E+10	4.86E+11	4.19E+11	86.34%	922
10-0	High Flow	68.19	2.10E+11	5.38E+12	5.17E+12	96.09%	3,224

Table 57E. Slater Branch (3754) TMDL and Estimated Needed Reductions

Percent of Time Flow is Equal or Exceeded	Flow Condition	Median Flow (ft³/s)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration Geometric Mean (cfu/100 mL)
100-90	Low Flow	0.29	8.87E+08	3.77E+08	0.00E+00	0.00%	54
90-60	Dry Conditions	0.84	2.58E+09	2.57E+09	0.00E+00	0.00%	125
60-40	Mid Range	1.71	5.28E+09	7.81E+09	2.53E+09	32.36%	186
40-10	Moist Conditions	3.84	1.18E+10	2.34E+10	0.00E+00	0.00%	250
10-0	High Flow	12.16	3.75E+10	2.04E+11	1.67E+11	81.65%	687

Appendix F: Hydrologic Soil Group Composition Tables

Table 58F. Hydrologic Soil Group Composition for the Dry Hollow Creek (3163) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	6.64	33.79%
Group B/D	1.30	6.62%
Group C	0.79	4.03%
Group C/D	5.54	28.19%
Group D	5.29	26.89%
Mines	0.00	0.00%
Pits and Dumps	0.10	0.48%
Water	0.00	0.00%
Total	19.66	100.00%

Table 59F. Hydrologic Soil Group Composition for the Spring River (3164) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	51.16	23.76%
Group B/D	9.91	4.60%
Group C	27.29	12.68%
Group C/D	37.80	17.56%
Group D	88.43	41.08%
Mines	0.00	0.00%
Pits and Dumps	0.65	0.30%
Water	0.05	0.02%
Total	215.29	100.00%

Table 60F. Hydrologic Soil Group Composition for the Spring River (3165) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	10.62	15.91%
Group B/D	3.59	5.38%
Group C	2.22	3.33%
Group C/D	14.39	21.56%
Group D	35.49	53.19%
Mines	0.00	0.00%
Pits and Dumps	0.42	0.62%
Water	0.01	0.01%
Total	*66.74	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 61F. Hydrologic Soil Group Composition for the Spring River trib. (4112) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.61	15.84%
Group B	1.41	36.62%
Group B/D	0.06	1.56%
Group C	1.44	37.41%
Group C/D	0.30	7.79%
Group D	0.03	0.78%
Mines	0.00	0.00%
Pits and Dumps	0.00	0.00%
Water	0.00	0.00%
Total	*3.85	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 62F. Hydrologic Soil Group Composition for the Honey Creek (3169) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	14.32	21.19%
Group B/D	2.99	4.42%
Group C	12.53	18.54%
Group C/D	11.41	16.88%
Group D	26.10	38.63%
Mines	0.00	0.00%
Pits and Dumps	0.23	0.34%
Water	0.00	0.00%
Total	*67.58	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 63F. Hydrologic Soil Group Composition for the Honey Creek (3170) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	4.50	39.83%
Group B/D	0.10	0.88%
Group C	2.60	23.01%
Group C/D	0.60	5.31%
Group D	3.50	30.97%
Mines	0.00	0.00%
Pits and Dumps	0.00	0.00%
Water	0.00	0.00%
Total	*11.30	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 64F. Hydrologic Soil Group Composition for the Williams Creek (3171) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	16.12	29.59%
Group B/D	1.66	3.04%
Group C	8.31	15.26%
Group C/D	9.96	18.28%
Group D	18.39	33.75%
Mines	0.00	0.00%
Pits and Dumps	0.00	0.01%
Water	0.04	0.07%
Total	54.48	100.00%

Table 65F. Hydrologic Soil Group Composition for the Williams Creek (3172) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	15.92	29.54%
Group B/D	1.64	3.04%
Group C	8.31	15.42%
Group C/D	9.82	18.21%
Group D	18.17	33.71%
Mines	0.00	0.00%
Pits and Dumps	0.00	0.01%
Water	0.04	0.07%
Total	*53.90	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 66F. Hydrologic Soil Group Composition for the Truitt Creek (3174) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	11.40	40.06%
Group B/D	0.46	1.63%
Group C	2.79	9.82%
Group C/D	3.85	13.52%
Group D	9.92	34.86%
Mines	0.00	0.00%
Pits and Dumps	0.00	0.01%
Water	0.03	0.10%
Total	*28.45	100.00%

* Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 67F. Hydrologic Soil Group Composition for the Truitt Creek (3175) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	10.53	41.80%
Group B/D	0.32	1.27%
Group C	2.55	10.12%
Group C/D	3.03	12.03%
Group D	8.73	34.66%
Mines	0.00	0.00%
Pits and Dumps	0.00	0.00%
Water	0.03	0.12%
Total	25.19	100.00%

Table 68F. Hydrologic Soil Group Composition for the White Oak Creek (3182) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	3.33	5.27%
Group B	12.01	19.00%
Group B/D	0.66	1.04%
Group C	18.07	28.58%
Group C/D	6.94	10.98%
Group D	22.13	35.00%
Mines	0.00	0.00%
Pits and Dumps	0.00	0.00%
Water	0.08	0.13%
Total	*63.22	100.00%

* Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 69F. Hydrologic Soil Group Composition for the North Fork Spring River (3186) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	7.50	1.17%
Group B	62.90	9.80%
Group B/D	3.90	0.61%
Group C	161.80	25.22%
Group C/D	138.10	21.52%
Group D	262.90	40.98%
Mines	0.50	0.08%
Pits and Dumps	1.30	0.20%
Water	2.70	0.42%
Total	*641.60	100.00%

* Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 70F. Hydrologic Soil Group Composition for the North Fork Spring River (3188) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	2.60	0.69%
Group B	22.40	5.98%
Group B/D	2.64	0.70%
Group C	98.80	26.37%
Group C/D	65.00	17.35%
Group D	180.40	48.16%
Mines	0.00	0.00%
Pits and Dumps	1.20	0.32%
Water	1.60	0.43%
Total	*374.64	100.00%

* Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 71F. Hydrologic Soil Group Composition for the Dry Fork (3189) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	1.80	1.88%
Group B	30.30	31.64%
Group B/D	1.30	1.36%
Group C	8.90	9.30%
Group C/D	44.60	46.57%
Group D	8.70	9.09%
Mines	0.00	0.00%
Pits and Dumps	0.00	0.00%
Water	0.15	0.16%
Total	*95.75	100.00%

* Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 72F. Hydrologic Soil Group Composition for the Opossum Creek (3190) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	0.85	5.98%
Group B/D	0.00	0.00%
Group C	0.75	5.28%
Group C/D	11.57	81.64%
Group D	0.97	6.87%
Mines	0.00	0.00%
Pits and Dumps	0.01	0.04%
Water	0.03	0.19%
Total	*14.18	100.00%

* Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 73F. Hydrologic Soil Group Composition for the Duval Creek (3199) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.08	0.43%
Group B	0.66	3.40%
Group B/D	0.00	0.00%
Group C	10.20	52.16%
Group C/D	0.91	4.66%
Group D	7.58	38.76%
Mines	0.00	0.00%
Pits and Dumps	0.01	0.03%
Water	0.11	0.56%
Total	19.55	100.00%

Table 74F. Hydrologic Soil Group Composition for the Slater Branch (3754) watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Group A	0.00	0.00%
Group B	0.14	4.35%
Group B/D	0.00	0.00%
Group C	1.72	53.41%
Group C/D	0.14	4.35%
Group D	1.18	36.65%
Mines	0.00	0.00%
Pits and Dumps	0.00	0.00%
Water	0.04	1.24%
Total	*3.22	100.00%

* Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Appendix G: Land Use Land Cover Composition Tables for Each Impaired Watershed

Table 75G. Dry Hollow Creek (3163) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.01	0.46%
Developed, Medium Intensity	0.10	1.51%
Developed, Low Intensity	0.35	4.57%
Developed, Open Space	0.82	3.18%
Barren Land	0.01	0.05%
Cultivated Crops	0.73	3.25%
Hay and Pasture	14.20	73.84%
Scrub and Herbaceous	0.15	0.54%
Forest	3.22	12.15%
Wetlands	0.06	0.37%
Open Water	0.01	0.08%
Total	19.66	100.00%

Table 76G. Spring River (3164) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.98	0.46%
Developed, Medium Intensity	3.25	1.51%
Developed, Low Intensity	9.85	4.57%
Developed, Open Space	6.85	3.18%
Barren Land	0.11	0.05%
Cultivated Crops	7.00	3.25%
Hay and Pasture	158.97	73.84%
Scrub and Herbaceous	1.17	0.54%
Forest	26.16	12.15%
Wetlands	0.80	0.37%
Open Water	0.17	0.08%
Total	*215.31	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 77G. Spring River (3165) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.46	0.68%
Developed, Medium Intensity	1.11	1.66%
Developed, Low Intensity	3.62	5.43%
Developed, Open Space	2.32	3.47%
Barren Land	0.04	0.06%
Cultivated Crops	1.18	1.77%
Hay and Pasture	46.59	69.81%
Scrub and Herbaceous	0.40	0.60%
Forest	10.74	16.10%
Wetlands	0.26	0.38%
Open Water	0.03	0.04%
Total	*66.75	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 78G. Spring River tributary (4112) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.03	0.70%
Developed, Medium Intensity	0.11	2.73%
Developed, Low Intensity	0.28	7.23%
Developed, Open Space	0.27	7.02%
Barren Land	0.0003	0.01%
Cultivated Crops	0.30	7.78%
Hay and Pasture	2.29	59.38%
Forest	0.56	14.62%
Wetlands	0.01	0.29%
Open Water	0.01	0.24%
Total	3.86	100.00%

Table 79G. Honey Creek (3169) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.14	0.20%
Developed, Medium Intensity	0.64	0.95%
Developed, Low Intensity	2.75	4.07%
Developed, Open Space	2.30	3.41%
Barren Land	0.02	0.04%
Cultivated Crops	1.95	2.88%
Hay and Pasture	50.71	75.06%
Scrub and Herbaceous	0.50	0.74%
Forest	8.35	12.36%
Wetlands	0.14	0.21%
Open Water	0.05	0.08%
Total	*67.55	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 80G. Honey Creek (3170) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.076	0.67%
Developed, Medium Intensity	0.284	2.50%
Developed, Low Intensity	0.989	8.69%
Developed, Open Space	0.500	4.40%
Barren Land	0.004	0.04%
Cultivated Crops	0.330	2.90%
Hay and Pasture	8.664	76.12%
Scrub and Herbaceous	0.041	0.36%
Forest	0.483	4.24%
Wetlands	0.003	0.03%
Open Water	0.006	0.05%
Total	*11.380	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 81G. Williams Creek (3171) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.36	0.66%
Developed, Medium Intensity	1.22	2.24%
Developed, Low Intensity	2.75	5.05%
Developed, Open Space	1.63	2.98%
Barren Land	0.05	0.08%
Cultivated Crops	0.94	1.73%
Hay and Pasture	42.47	77.95%
Scrub and Herbaceous	0.16	0.30%
Forest	4.71	8.65%
Wetlands	0.12	0.21%
Open Water	0.08	0.15%
Total	*54.49	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 82G. Williams Creek (3172) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.36	0.66%
Developed, Medium Intensity	1.21	2.25%
Developed, Low Intensity	2.73	5.06%
Developed, Open Space	1.61	2.98%
Barren Land	0.05	0.08%
Cultivated Crops	0.90	1.68%
Hay and Pasture	42.21	78.35%
Scrub and Herbaceous	0.16	0.30%
Forest	4.50	8.35%
Wetlands	0.07	0.14%
Open Water	0.08	0.15%
Total	53.88	100.00%

Table 83G. Truitt Creek (3174) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.03	0.10%
Developed, Medium Intensity	0.21	0.72%
Developed, Low Intensity	0.76	2.66%
Developed, Open Space	0.64	2.23%
Barren Land	0.04	0.13%
Cultivated Crops	0.46	1.61%
Hay and Pasture	24.55	86.30%
Scrub and Herbaceous	0.07	0.23%
Forest	1.62	5.69%
Wetlands	0.02	0.08%
Open Water	0.06	0.22%
Total	28.46	100.00%

Table 84G. Truitt Creek (3175) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.02	0.08%
Developed, Medium Intensity	0.15	0.60%
Developed, Low Intensity	0.60	2.37%
Developed, Open Space	0.55	2.17%
Barren Land	0.03	0.14%
Cultivated Crops	0.46	1.82%
Hay and Pasture	21.92	87.07%
Scrub and Herbaceous	0.06	0.26%
Forest	1.31	5.19%
Wetlands	0.02	0.08%
Open Water	0.06	0.22%
Total	*25.18	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 85G. White Oak Creek (3182) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.03	0.04%
Developed, Medium Intensity	0.20	0.32%
Developed, Low Intensity	0.66	1.04%
Developed, Open Space	1.90	3.00%
Barren Land	0.01	0.02%
Cultivated Crops	6.53	10.33%
Hay and Pasture	41.37	65.47%
Scrub and Herbaceous	0.79	1.25%
Forest	11.50	18.20%
Wetlands	0.07	0.10%
Open Water	0.14	0.23%
Total	63.20	100.00%

Table 86G. North Fork Spring River (3186) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.68	0.11%
Developed, Medium Intensity	3.81	0.59%
Developed, Low Intensity	10.96	1.71%
Developed, Open Space	16.27	2.54%
Barren Land	0.39	0.06%
Cultivated Crops	272.93	42.52%
Hay and Pasture	266.70	41.56%
Scrub and Herbaceous	2.31	0.36%
Forest	54.97	8.57%
Wetlands	9.44	1.47%
Open Water	3.25	0.51%
Total	641.71	100.00%

Table 87G. North Fork Spring River (3188) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.59	0.16%
Developed, Medium Intensity	2.70	0.72%
Developed, Low Intensity	7.23	1.93%
Developed, Open Space	9.51	2.54%
Barren Land	0.27	0.07%
Cultivated Crops	168.03	44.85%
Hay and Pasture	150.94	40.29%
Scrub and Herbaceous	1.21	0.32%
Forest	26.10	6.97%
Wetlands	6.16	1.64%
Open Water	1.92	0.51%
Total	374.66	100.00%

Table 88G. Dry Fork (3189) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.05	0.05%
Developed, Medium Intensity	0.51	0.53%
Developed, Low Intensity	1.25	1.31%
Developed, Open Space	2.60	2.72%
Barren Land	0.04	0.04%
Cultivated Crops	34.15	35.70%
Hay and Pasture	49.34	51.59%
Scrub and Herbaceous	0.35	0.37%
Forest	6.69	7.00%
Wetlands	0.42	0.44%
Open Water	0.24	0.25%
Total	*95.64	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 89G. Opossum Creek (3190) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.04	0.28%
Developed, Medium Intensity	0.21	1.52%
Developed, Low Intensity	0.52	3.69%
Developed, Open Space	0.47	3.29%
Barren Land	0.0003	0.002%
Cultivated Crops	5.04	35.55%
Hay and Pasture	7.01	49.43%
Scrub and Herbaceous	0.03	0.23%
Forest	0.79	5.55%
Wetlands	0.01	0.06%
Open Water	0.06	0.40%
Total	*14.18	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 90G. Duval Creek (3199) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.003	0.02%
Developed, Medium Intensity	0.05	0.23%
Developed, Low Intensity	0.22	1.14%
Developed, Open Space	0.48	2.44%
Barren Land	0.01	0.03%
Cultivated Crops	7.07	36.16%
Hay and Pasture	8.23	42.08%
Scrub and Herbaceous	0.11	0.57%
Forest	3.23	16.51%
Wetlands	0.02	0.12%
Open Water	0.14	0.71%
Total	*19.56	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in the Water Body Summary.

Table 91G. Duval Creek (3199) Land Cover Composition

Land Cover Type	Area in the Watershed	
	Square Miles	Percent
Developed, High Intensity	0.0003	0.01%
Developed, Medium Intensity	0.01	0.21%
Developed, Low Intensity	0.07	2.01%
Developed, Open Space	0.08	2.42%
Cultivated Crops	1.56	44.78%
Hay and Pasture	1.46	41.96%
Scrub and Herbaceous	0.02	0.48%
Forest	0.23	6.69%
Wetlands	0.0003	0.01%
Open Water	0.05	1.43%
Total	*3.48	100.00%

*Due to rounding and data resolution, this value differs slightly from the calculated watershed area presented in S the Water Body Summary.

Appendix H: High Priority Areas for BMP Implementation

As mentioned in Section 13.1, priority subwatersheds for plan implementation were delineated as a part of the Watershed Plan in 2015. Refer to Section 4 of the Watershed Plan to read their approach to assigning high, moderate, and low priority subwatersheds. For implementation of this TMDL, the primary focus will be on the high priority subwatersheds located upstream of Spring River (3160). Approximately 70% of the Spring River (3160) watershed was assigned as high priority subwatersheds for plan implementation. Those subwatersheds received their high priority ranking for reasons such as existing or planned TMDLs, or public water supplies. The high priority waterbodies and their associated watersheds listed in the Watershed Plan that are also addressed by this TMDL are North Fork Spring River, Dry Fork, Spring River, White Oak Creek, and Honey Creek. The goal of assigning high priority subwatersheds is to streamline the most effective BMPs to targeted areas to receive the biggest bang for the buck in terms of pollutant load reductions. The BMPs listed in the Watershed Plan's Section 5 that could be implemented in the high priority subwatersheds are organized into agricultural, streambank, septic system, and urban BMPs. For *E. coli* and bacteria reductions from rural areas the most effective BMPs would be in the agricultural, streambank, and septic system categories.

TMDLs often show GIS analysis that provide target areas for riparian corridor BMPs such as tree planting, prairie strip buffers, streambank stabilization, and livestock removal. As mentioned in Section 5.2.5 riparian corridors are the areas within 100 ft of a stream. Priority riparian corridors for BMP implementation are chosen for having soils rated as Class D, low soil infiltration, and land cover class of cropland or hay and pasture. This accounts for 297 miles of streams and tributaries within the Spring River (3160) watershed that are adjacent to priority riparian corridors for BMP implementation. There are approximately 1,788 miles of streams total within the watershed which means about 11 percent of streams within the Spring River (3160) watershed are adjacent to priority riparian corridors. Furthermore, there are approximately 150 miles of streams adjacent to priority riparian corridors and also within the high priority subwatersheds designated by the Watershed Plan. Ground truthing or stream surveys should be conducted to confirm streambank and buffer area conditions prior to initiating implementation planning.

Figure 81H below shows the high priority subwatersheds for BMP implementation within the Spring River (3160) watershed as assigned by the Watershed Plan already. It also shows the stream segments that are adjacent to high priority riparian corridors. The majority of these riparian corridors are in the northwest region of the watershed that would be draining through the North Fork Spring River (3188). As mentioned in Section 5.2.5 and shown in Table 15, the total square miles of high priority riparian corridor is approximately 36 square miles, which is approximately 54% of the total riparian corridor.

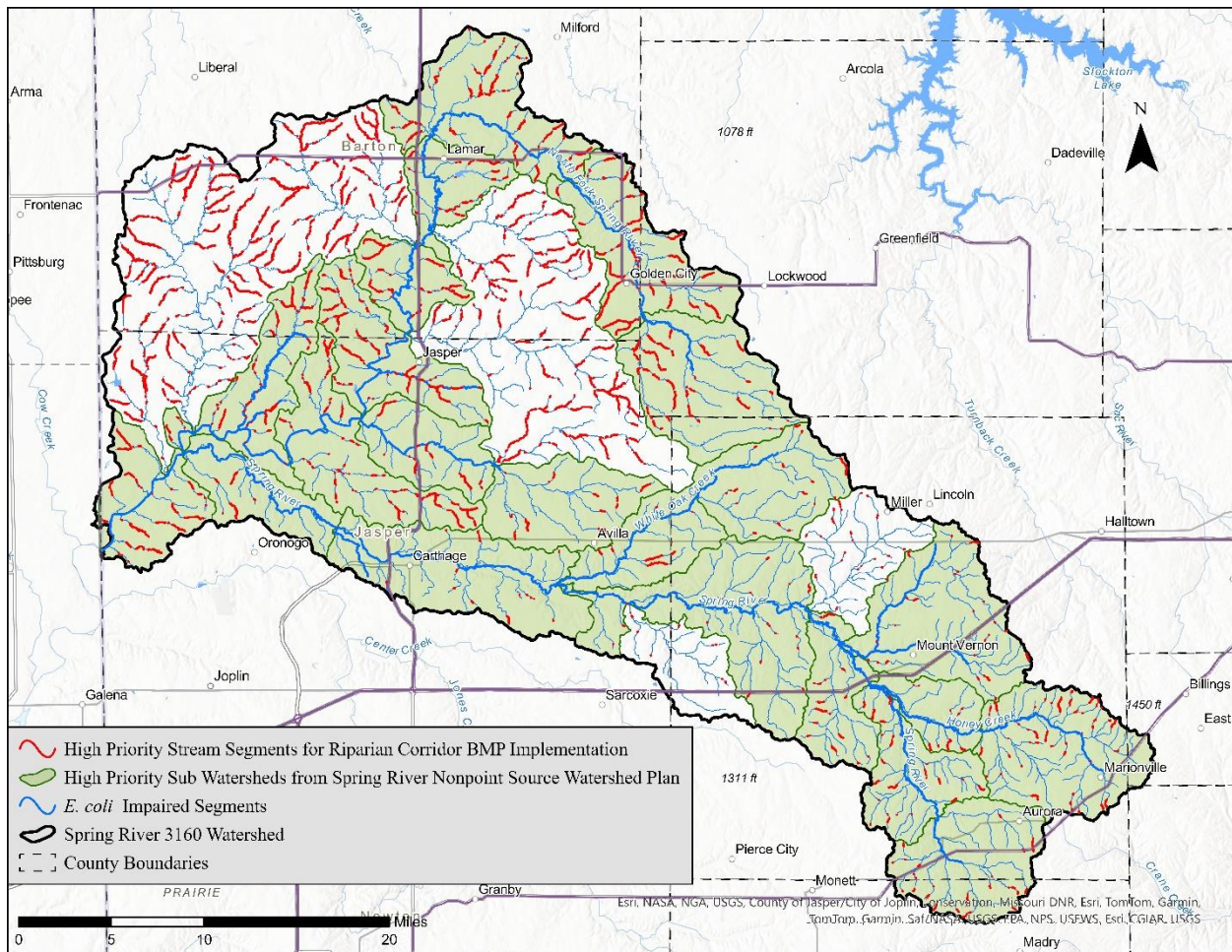


Figure 81H. High Priority Areas for BMP Implementation

Appendix I: Soil and Water Conservation Program Implemented BMPs for *E. coli* Reductions.

The Missouri Soil and Water Conservation Program provides cost-share for a variety of BMPs that support reductions of *E. coli* loading from agricultural lands. Table 92I summarize practices implemented in the Spring River watershed from 2019 through 2023 that can help reduce *E. coli* loads in water bodies. Additional information regarding soil and water conservation cost-share practices in Missouri is available online at <https://dnr.mo.gov/land-geology/businesses-landowners-permittees/financial-technical-assistance/soil-water-conservation-cost-share-practices>. Interested landowners that would like assistance implementing any soil and water conservation practices are encouraged to contact their local soil and water conservation district office to see what cost-share practices are available in your district.

Table 92I. Soil and Water Conservation Practices in the Spring River (3160) Watershed

Year	Practice	Number of Practices	<i>E. coli</i> Reduction Area (Acres)
2019	Cover Crop	75	5,133.90
	Field Border	1	0.60
	Grazing System Fence	7	615.00
	Grazing System Seed	3	262.00
	Grazing System Water Development	2	181.90
	Grazing System Water Distribution	6	457.40
	Livestock Exclusion	1	8.58
	Permanent Vegetative Cover Establishment	7	167.30
	Stream Protection	2	16.00
	Well Decommissioning	4	0.00
	Totals	108	6,842.68
Year	Practice	Number of Practices	<i>E. coli</i> Reduction Area (Acres)
2020	Cover Crop	27	1,795.60
	Grazing System Fence	13	778.80
	Grazing System Water Development	4	213.90
	Grazing System Water Distribution	12	650.50
	Livestock Exclusion	1	4.70
	Permanent Vegetative Cover Establishment	7	146.00
	Well Decommissioning	2	0.00
	Total	66	3,589.50
Year	Practice	Number of Practices	<i>E. coli</i> Reduction Area (Acres)
2021	Cover Crop	20	1,323.23
	Grazing System Fence	10	732.25
	Grazing System Water Development	8	716.45
	Grazing System Water Distribution	12	844.00
	Livestock Exclusion	1	9.30
	Permanent Vegetative Cover Establishment	6	166.20
	Stream Protection	1	11.06
	Well Decommissioning	3	0.00

	Total	61	3,802.49
Year	Practice	Number of Practices	<i>E. coli</i> Reduction Area (Acres)
2022	Cover Crop	21	827.25
	Grazing System Fence	7	372.69
	Grazing System Water Development	2	171.26
	Grazing System Water Distribution	7	171.26
	Livestock Exclusion	2	19.25
	Permanent Vegetative Cover Enhancement	7	138.04
	Stream Protection	2	26.23
	Total	48	1,725.98
Year	Practice	Number of Practices	<i>E. coli</i> Reduction Area (Acres)
2023	Cover Crop	59	3,794.30
	Grazing System Fence	3	299.03
	Grazing System Water Development	2	123.00
	Grazing System Water Distribution	5	292.81
	Livestock Exclusion	1	6.17
	Permanent Vegetative Cover Enhancement	1	35.60
	Permanent Vegetative Cover Establishment	4	157.70
	Stream Protection	2	18.62
	Well Decommissioning	1	0
	Total	78	4,727.23

Appendix J: Protective TMDL Streams

Table 93J. Protective TMDL Streams

WBID	Water Body Name	Protected Designated Uses
3167	Spring R.	WBC-B, SCR
3810	Douger Br.	WBC-B, SCR
3184	Blackberry Cr.	WBC-B, SCR
3178	Dry Fork	WBC-B, SCR
3161	Trib. to Spring R.	WBC-B, SCR
3162	Cave Spring Br.	WBC-B, SCR
3166	Browning Hollow	WBC-B, SCR
3168	Chat Creek	WBC-B, SCR
3173	Williams Cr.	WBC-B, SCR
3176	Stahl Cr.	WBC-B, SCR
3177	Trib. to Stahl Cr.	WBC-B, SCR
3179	Trib. to Spring R.	WBC-B, SCR
3180	Trib. to Spring R.	WBC-B, SCR
3181	Trib. to Spring R.	WBC-B, SCR
3183	Trib. to White Oak Cr.	WBC-B, SCR
3185	Pond Cr.	WBC-B, SCR
3187	Buck Branch	WBC-B, SCR
3191	Coon Cr.	WBC-B, SCR
3192	L. Coon Cr.	WBC-B, SCR
3193	Pettis Cr.	WBC-B, SCR
3194	Coon Cr.	WBC-B, SCR
3195	Kyle Cr.	WBC-B, SCR
3196	Trib. to N. Fk. Spring R.	WBC-B, SCR
3197	Dicks Fk.	WBC-B, SCR
3198	West Fk.	WBC-B, SCR
3200	L. N. Fork	WBC-B, SCR
3201	Trib. to L. N. Fk. Spring R.	WBC-B, SCR
3202	Glendale Fk.	SCR
3999	Buck Branch tributary	WBC-B, SCR
4006	Williams Creek tributary	WBC-B, SCR
4068	Buck Branch tributary	WBC-B, SCR
4101	Truitt Creek tributary	SCR